User's Manual

Link controller for multi-axes stages

HIT-M / HIT-S

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For Your Safety

Before using this product, read this manual and all warnings or cautions in the documentation provided.

Only Factory Authorized Personnel should be changes and/or adjust the parts of controller.

The Symbols Used in This Manual

⚠ WARNING	⚠ CAUTION
This symbol marks warnings that should be read and used to prevent serious injury or death.	This symbol indicates where caution should be used to avoid possible injury to yourself or others, or damage to property.

The above indications are used together with the following symbols to indicate the exact nature of the warning or caution.

Examples of Symbols Accompanying Warnings and Cautions	
	△Symbols enclosed in a triangle indicate warnings and cautions. The exact nature of the warning or caution is indicated by the symbol inside (the symbol at left indicates risk of electrocution).
	○Symbols enclosed in a circle mark indicate prohibitions(actions that must not be performed).The exact nature of the prohibition is indicates by the symbol inside or next to the circle mark (the symbol at left indicates that the product must not be disassembled).
	●Symbols inside a black circle mark actions that must be performed to ensure safety. The exact nature of the action that must be performed is indicated by the symbol inside (the symbol at left is used in cases in which the AC adapter must be unplugged to ensure safety).

Symbols on the product

The symbol mark on the product calls your attention. Please refer to the manual, in the case that you operate the part of the symbol mark on the product.

	This symbol labeled on the portion calls your attention.

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① SIGMAKOKI CO., LTD. does not accept liability for damages resulting from the use of this product or the inability to use this product.

② SIGMAKOKI CO., LTD. does not accept liability for damages resulting from the use of this product that deviates from that described in the manual.

③ SIGMAKOKI CO., LTD. does not accept liability for damages resulting from the use of this product in extraordinary conditions, including fire, earthquakes, and other acts of God, action by any third party, other accidents, and deliberate or accidental misuse.

④ If the equipment is used in a manner not specified by the SIGMAKOKI CO., LTD., the protection provided by the equipment may be impaired.

WARNING

- Do not use this product in the presence of flammable gas, explosives, or corrosive substances, in areas exposed to high levels of moisture or humidity, in poorly ventilated areas, or near flammable materials.
- Do not connect or check the product while the power is on.
- Installation and connection should be performed only by a qualified technician.
- Do not bend, pull, damage, or modify the power or connecting cables.
- Do not touch the products internal parts.
- Connect the earth terminal to ground.
- Should the product overheat, or should you notice an unusual smell, heat, or unusual noises coming from the product, turn off the power immediately.
- Do not turn on the power in the event that it has received a strong physical shock as the result of a fall or other accident.
- Do not touch the stage while operation.
- Use dry clothes only for cleaning the equipment.

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Chapter 1: Before You Begin

1-1.Package Contents

Purchasers of the Stage Controller should find that the package contains the items listed below. Check the package contents using the following checklist. Contact your retailer as soon as possible in the event that you should find that any item is missing or damaged.

As HIT-M or HIT-S is selling indivisually, please take care of this point when you purchase.

HIT-M set

☐HIT-M Stage Controller

☐User's Manual (This Manual)

HIT-S set

☐HIT-S Stage Controller

☐LAN Cable (0.6m)

Option

☐PAT-POW (DC24V Power Supply)

1-2.Overview

This controller is a Multi-Axes Moterized Stage Controller built in 5 Phase stepping motor Driver (Maximum 8 axes' connection possible). Since micro-step driver is installed, it is possible to be done with high resolutional operation and positioning.

When HIT-M is connected to an ordinary personal computer via an RS232C, USB or LAN interface, the stage can be accurately moved to the desired position by simple commands sent from the PC.

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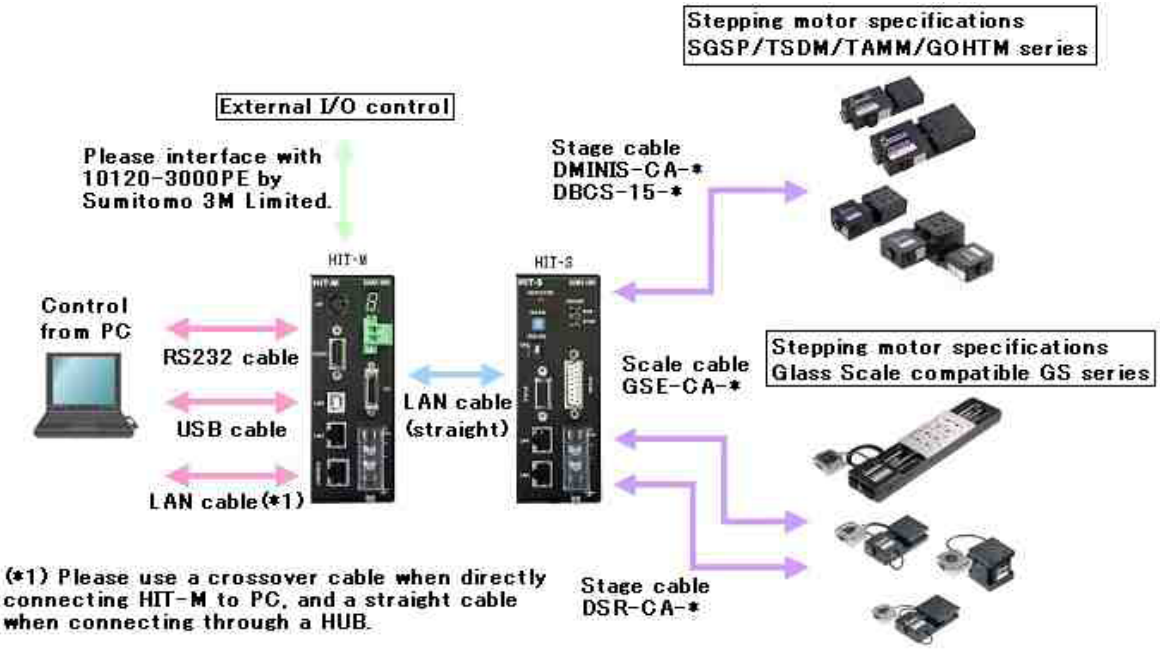
1-3.HIT-M, HIT-S System Diagram



(*) In case of connection between PC and HIT-H directry please use cross cable, and in case of connection through HUB please use straight cable.

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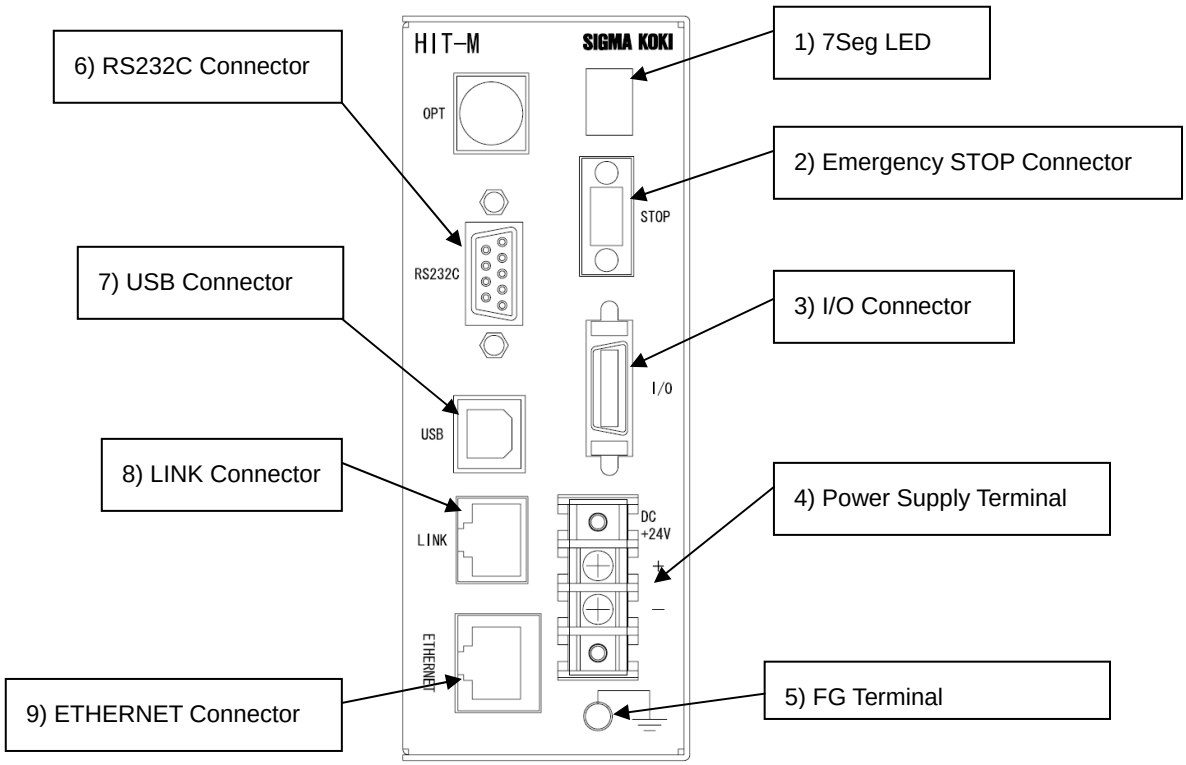
1-4.Parts and Functions

HIT-M Front Panel



1) 7 Segment LED : When Power (DC24V) is supplied, it shows No.of axis connected for approx.4 seconds, then dot in LED box flashes.

2) Emergency Stop Connector : It connects with Emergency Stop Switch. Please refer to 「4-5 Emergency STOP」 for further details.

3) I/O Connector : It interfaces with input/output signal for external devices.

4) Power Supply Terminal : Supply Power (DC +24V 1A)

5) FG Terminal : It is Terminal for Frame Ground. Please connect to Earth in the actual environment.

6) RS232C Connector : When control by RS232C Interface through PC, please use RS232C.

7) USB Connector : When control by USB Interface trough PC, please use USB.

8) LINK Connector :In case of connection between HIT-M and HIT-S, connect with using attached straight LAN cable.

9) ETHERNET Connector : In case of connection through Ethernet from PC, connect with using straight or cross LAN cable.

⚠ Make sure to set up and wire the cable supplying DC+24V and FG_GND to the HIT-M so that the maximum length of cable is not longer than 2m.

⚠ For your own safety, make sure POWER is OFF before connecting every cable.

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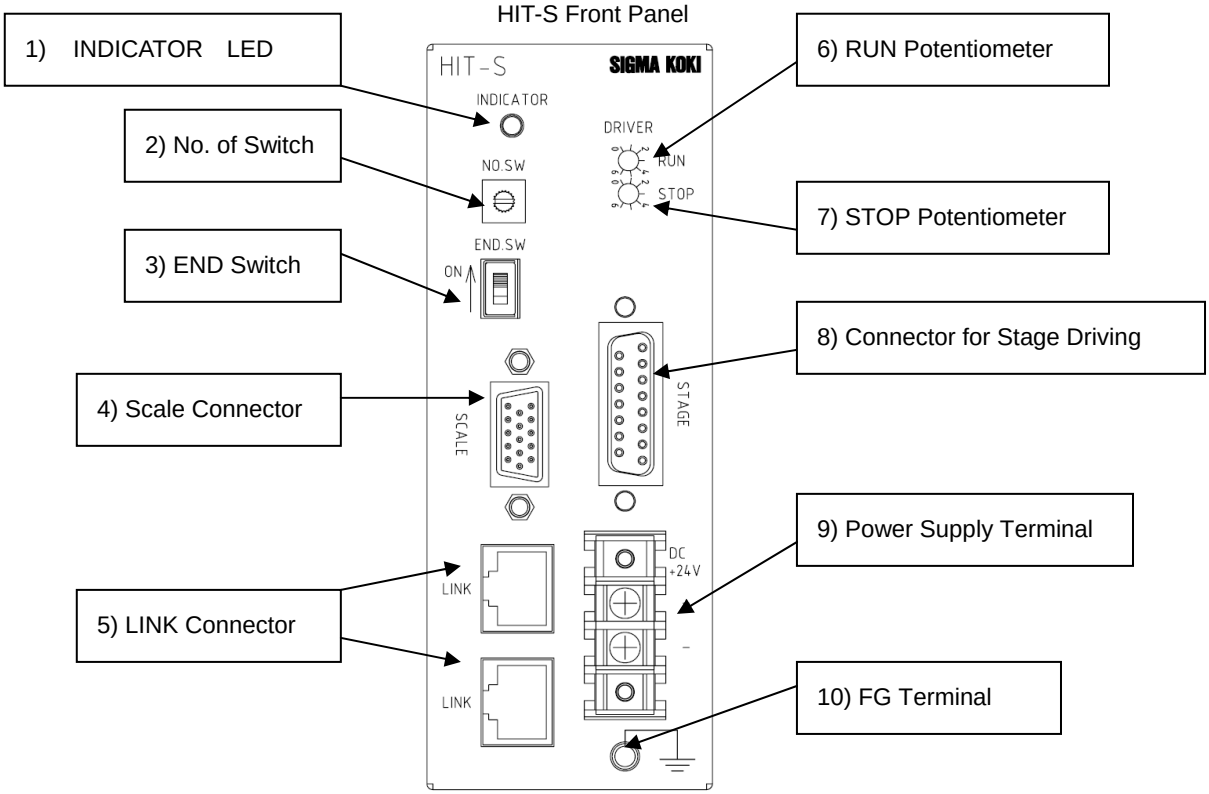
HIT-S Front Panel



1) INDICATOR LED : Shows the HIT-S condition. When it is booted with no fault, LED flashes. In case of fault-booting, LED light is on.

2) No.Switch : Sets the HIT-S address. Please refer to「2-2 Interface between HIT-M and HIT-S」for further details.

3) END Switch : Sets the terminating node. Please refer to「2-2 Interface between HIT-M and HIT-S」for further details.

4) Scale Connector : Connects to the cable attached to the Glass Scale in use.

5) LINK Connector : Connects to a straight LAN cable, for connecting HIT-M and HIT-S.

6) RUN Potentiometer : The current delivered when the motor is moving can be set by adjusting RUN potentiometer above. Please refer to「3-1 settings for motor driving current」for further details.

7) STOP Potentiometer : The current delivered when the motor is stopped can be set by adjusting STOP potentiometer above. Please refer to「3-1 settings for motor driving current」for further details.

8) Connector for Stage Driver : Connects to the cable attached to the motorized stage in use.

9) Power Supply Terminal :DC +24V 1A Power Supply

10) FG Terminal :Frame Ground Terminal. Please connect to EARTH when using.

⚠ Make sure to set up and wire the cable supplying DC+24V and FG_GND to the HIT-S so that the maximum length of cable is not longer than 2m.

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⚠ For your own safety, make sure POWER is OFF before connecting every cable.

Chapter 2: Connection Flow

2-1.Connection between HIT-S and motorized stage

First, connect HIT-S and every mtorized stage. Here it shows the case that TSDM(GS)60-15X with built in glass scale is connected to HIT-S.

① Connect tne connector (round connector 10p: Female) of TSDM(GS)60-15X with standard cable(DHR-CA)

② Connect the connector of “STAGE” of FRONT Panel with the other side of standard cable (DHR-CA) connected to TSDM(GS)60-15X in No.1 procedure.

③ Connect tne scale connector of TSDM(GS)60-15X with standard cable (GSE-CA)

④ Connect the scale connector of “SCALE” of FRONT Panel with the other side of standard cable (GSE-CA) connected to TSDM(GS)60-15X in No.3 procedure.

2-2.Interface between HIT-M and HIT-S

(1) How to connect HIT-M and HIT-S

Please connect HIT-M LINK connector and HIT-S LINK connector (address 0) with straight LAN cable.

When 2 axes are in need, which means 2 HIT-S are being used, please connect a LINK connector on 1st HIT-S (address 0) and the other LINK connector on 2nd HIT-S (address 1) with straight LAN cable.

IN this case, please set the END.Switch on 2nd HIT-S (address 1) ON.

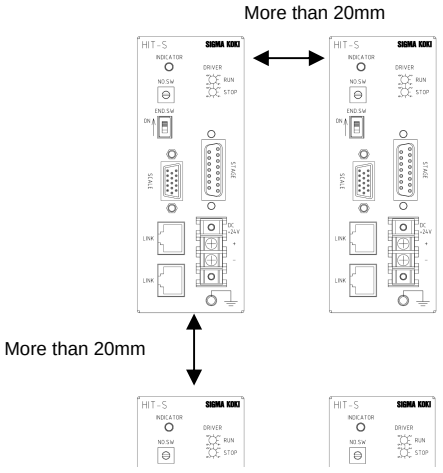
(2) No. Switch

Up to 8 stages, numbered from 0 to 7, can be controlled by setting address No.s of HIT-S with No.Switch.

(3) Terminating node

Please set terminating node by switching on END.Switch in HIT-S.

***) When a stand (more than two) displays plural HIT-M/HIT-S and installs it, please keep it away more than 20mm to a horizontal direction and vertical directions.**



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2-3.Interface with PC

(1) RS232C Connection

Please connect by using RS232C (RS232C/STR) cable. In this case, please set the memory switch (Interface) to RS232C.

(2) USB Connection

Please connect by using USB cable. In this case, please set the memory switch (Interface) to USB.

(3) LAN connection

Please connect by using LAN crossover cable (LAN-CA). However, please use straight LAN cable when connecting via HUB. Then, set Memory Switch (INTFACE) to Ethrnet.

[**192.168.0.1**] and [**255.255.255.0**] are set as default value for IP address of HIT-M and Subnet Mask respectively. Please set IP address for PC to [**192.168.0.X**] (X can be any number from 0 to 255.) and Subnet Mask [**255.255.255.0**] in order for PC to be able to communicate with HIT-M. With regard to LAN settings for HIT-M, please refer to「**3-4 LAN Settings**」.

2-4.Power Supply

Power supply should be done as instructed below. Use DC24V for both HIT-M and HIT-S.

① First, switch HIT-S on.

② Next, switch HIT-M on. 7 Seg LED on HIT-M will show the No. of axis of HIT-S connected to HIT-M for approx. 4 seconds, and dot in LED will start to flicker.

(Please ensure to follow the Power Supply order instructed above, because communication between HIT-M and HIT-S can not be completed when location of terminating node is unsure.

*Note) They can also be switched on at the same time.

③ When HIT-M is switched on, “INDICATOR” LED on HIT-S flashes.

(”INDICATOR” LED is still lighted when only HIT-S is switched on, or when fault-interface has been made between HIT-M and HIT-S.)

Communication between HIT-M and HIT-S can be made when ”INDICATOR” LED flashes.

Please switch HIT-M on once again when LED is still lighted.

④ Dot in 7Seg LED on HIT-M flashes in good condition.

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Chapter 3: Settings

3-1.Settings Motor Driving Current

Motor driving current on HIT-S should be set in accordance with stage in use. (RUN/STOP) Potentiometer is on the front side of HIT-S. (Please refer to Diagram 3-1.)

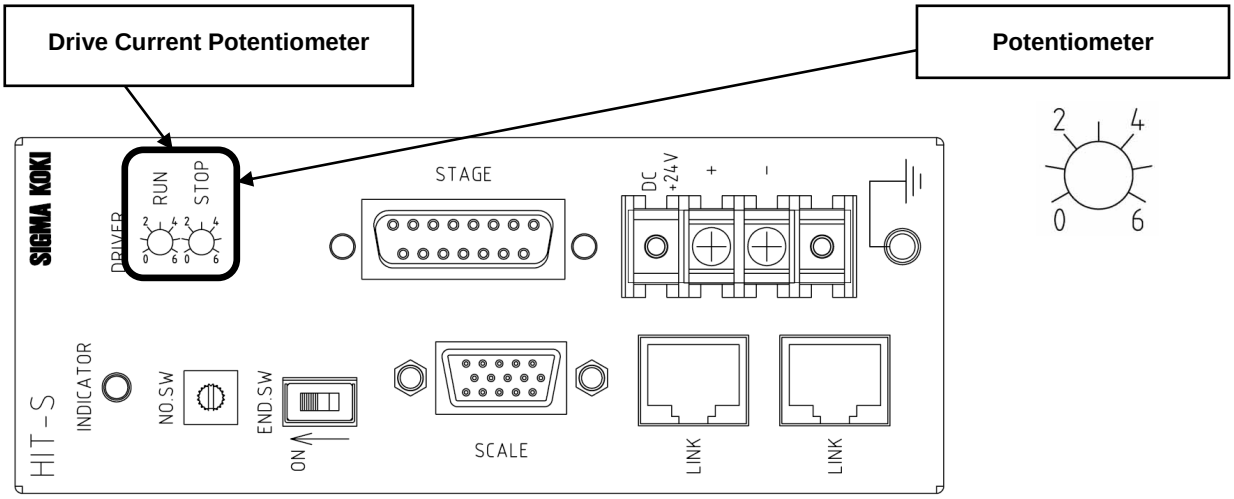

Diagram 3-1：HIT-S front side

Driving current settings (RUN current)

Driving current can be set with RUN potentiometer. Its factory default is set to 0.75A/Phase.

Pot. Scale	0	1	2	3	4	5	6
RUN current (A/Phase)	0	0.17	0.35	0.66	0.75	0.9	1.1

Stopping current settings (STOP current)

Electric current when the motor is stopped can be set with STOP potentiometer. STOP current is set as a percentage of the RUN current. Its factory default is set to approx. 50%.

*) STOP current is normally set to approx. 50% of RUN current. (Factory default setting)

Vol. Gradation	0	1	2	3	4	5	6
STOP Current(%)	0	10	21	35	50	60	68

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3-2.Memory Switch settings

The Memory Switches store the controller settings.

When changing Memory Switch settings use the Sample software (HIT Sample), which can be downloaded from **http://www.sigma-koki.com.**

3-3.Memory Switch contents list and detailed settings

3-3-1 General

No	Memory Switch contents	Setting Range / Select items	Default Value
1	Speed SEL	1 - 4	1
2	Speed 1(S)	1 - 999999999	10000
3	Speed 1(F)	1 - 999999999	100000
4	Speed 1(R)	1 - 1000	200
5	Speed 2(S)	1 - 999999999	30000
6	Speed 2(F)	1 - 999999999	300000
7	Speed 2(R)	1 - 1000	200
8	Speed 3(S)	1 - 999999999	70000
9	Speed 3(F)	1 - 999999999	700000
10	Speed 3(R)	1 - 1000	200
11	Speed 4(S)	1 - 999999999	100000
12	Speed 4(F)	1 - 999999999	1000000
13	Speed 4(R)	1 - 1000	200
14	MODE_SEL	SHOT/HIT	HIT
15	OUT Level	Normal High/Normal Low	Normal High
16	LED_ON	ON/OFF	ON

1) SPEED SEL: Speed selection at Power ON

Select the initial setting Speed No. at Power ON.

[Setting Range] 1 ~ 4

2)～13) Speed 1～4(S)(F)(R): Speed Setting

Set 4 kinds of travel stage Speed (minimum S, maximum F, and acceleration/deceleration time R) at Power ON.

[Setting Range]	S：1～500000 (Unit：pulse/s)	[SHOT mode]
	S：1～999999999 (Unit：0.01μm/s)	[HIT mode]
	F：1～500000 (Unit：pulse/s)	[SHOT mode]
	F：1～999999999 (Unit：0.01μm/s)	[HIT mode]
	R：1～1000 (Unit：ms)	[SHOTmode][HITmode]

*) Minimum S values should be set smaller than maximum F at Speed Setting.

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14) MODE_SEL: Operation mode Settting

Operation mode is set.

[Select Item] SHOT：SHOT mode (Compatible with SHOT-204MS/SHOT-304GS)

HIT：HIT mode

15) OUT Level: I/O Output signal logic Setting

Select Logic (Voltage level) for I/O output signal.

[Select item] Normal High：Hi level (Active low) normally

Normal Low：Lo level (Active High) normally

16) LED_ON: Display setting for 7seg LED on HIT-M and for LED display on HIT-S

Set ON or OFF for 7seg LED on HIT-M and for LED display on HIT-S.

[Select item] ON： Turn ON

OFF： Turn OFF

*) OFF setting for LED is available only at normal condition. At abnormal condition, LED will be light.

3-3-2 INTERFACE

No	Memory Switch contents	Setting Range / Select items	Default value
1	INTERFACE	RS232C / USB / Ethrnet	RS232C
2	RS232C_FLOW	ON / OFF	ON
3	Baudrate	4800/9600/19200/38400/57600	38400

1) INTFACE: Setting for communication Interface

Set communication method with HOST (PC).

[Select items] RS232C： RS232C Interface

USB： USB Interface

Ethrnet： Ethrnet Interface

2) RS232C_FLOW: Flow control setting on RS232C

Specify whether the controller will do flow control in RS232C communication.

[Select item] ON： Hardware (RTS/CTS control)

OFF：without Flow control

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3) Baudrate: Baudrate setting

Set the data communication speed for the RS232C Interface.

[Select item] 4800: 4800bps

9600：9600bps

19200：19200bps

38400：38400bps

57600：57600bps

3-3-3 Axis

No	Memory Switch contents	Setting range / Select items	Default Value
1	Divide0	1/2/4/5/8/10/20/25/40/50/80/100/125/200/250	20
2	Divide1	1/2/4/5/8/10/20/25/40/50/80/100/125/200/250	20
3	Divide2	1/2/4/5/8/10/20/25/40/50/80/100/125/200/250	20
4	Divide3	1/2/4/5/8/10/20/25/40/50/80/100/125/200/250	20
5	Divide4	1/2/4/5/8/10/20/25/40/50/80/100/125/200/250	20
6	Divide5	1/2/4/5/8/10/20/25/40/50/80/100/125/200/250	20
7	Divide6	1/2/4/5/8/10/20/25/40/50/80/100/125/200/250	20
8	Divide7	1/2/4/5/8/10/20/25/40/50/80/100/125/200/250	20
9	Base Rate0	1～1000	20
10	Base Rate1	1～1000	20
11	Base Rate2	1～1000	20
12	Base Rate3	1～1000	20
13	Base Rate4	1～1000	20
14	Base Rate5	1～1000	20
15	Base Rate6	1～1000	20
16	Base Rate7	1～1000	20
17	Move0	POS/NEG	POS
18	Move1	POS/NEG	POS
19	Move2	POS/NEG	POS
20	Move3	POS/NEG	POS
21	Move4	POS/NEG	POS
22	Move5	POS/NEG	POS
23	Move6	POS/NEG	POS
24	Move7	POS/NEG	POS
25	ORG0 SEL	0～6	1
26	ORG1 SEL	0～6	1

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27	ORG2 SEL	0～6	1
28	ORG3 SEL	0～6	1
29	ORG4 SEL	0～6	1
30	ORG5 SEL	0～6	1
31	ORG6 SEL	0～6	1
32	ORG7 SEL	0～6	1
33	ORG offset20	0～999999999	0
34	ORG offset21	0～999999999	0
35	ORG offset22	0～999999999	0
36	ORG offset23	0～999999999	0
37	ORG offset24	0～999999999	0
38	ORG offset25	0～999999999	0
39	ORG offset26	0～999999999	0
40	ORG offset27	0～999999999	0
41	EMG Excitation0	On/Off	On
42	EMG Excitation1	On/Off	On
43	EMG Excitation2	On/Off	On
44	EMG Excitation3	On/Off	On
45	EMG Excitation4	On/Off	On
46	EMG Excitation5	On/Off	On
47	EMG Excitation6	On/Off	On
48	EMG Excitation7	On/Off	On

1～8) Divide0～7: Divide setting

Set Divide for each axis.

[Select range] 1/2/4/5/8/10/20/25/40/50/80/100/125/200/250

9～16) Base Rate 0～7: Base Rate setting

Set the travel distance per 1 full step pulse for each axis.

In case of closed loop control at HIT mode or SHOT mode, connrect value must be set. Otherwise, it is not able to position correctly. (Setting Unit：0.1μm)

[Setting range] 1～1000 (0.1μm～100μm)

Reference:

	TSDM & SGSP-ACT	SGSP20 & TAMM	SGSP26	SGSP33	SGSP-YAW
Base Rate	10	20	40	120	5

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17～24) Move 0～7: Travel direction setting 0~7axis

Set + travel direction for each axis.

[Select item] POS：Positive rotation

NEG：Negative rotation

25～32) ORG0～6 SEL: Origin reset method setting

Set Origin reset method for each axis.

[Select item] 0：Origin reset OFF

1：ORG1

2：ORG2

3：ORG3

4：ORG4

5：ORG5

6：ORG6

*) Regarding each method, please refer to “Origin Rest Method”.

33～40) ORG offset20～27: ORG offset setting

Set ORG offset value for each axis (ORG1、ORG5、ORG6) at the ORG reset.

[Setting range] 0～999999999 (Unit：0.01μm)

*) When Setting range is set [0], ORG offset value is 0.5mm.

41～48) EMG Excitation 0～7: Motor Exitation setting at Emergency STOP.

Set Motor Exitation ON or OFF for each axis at at Emergency STOP.

[Select item] ON：Exitation ON

OFF：Exitation OFF

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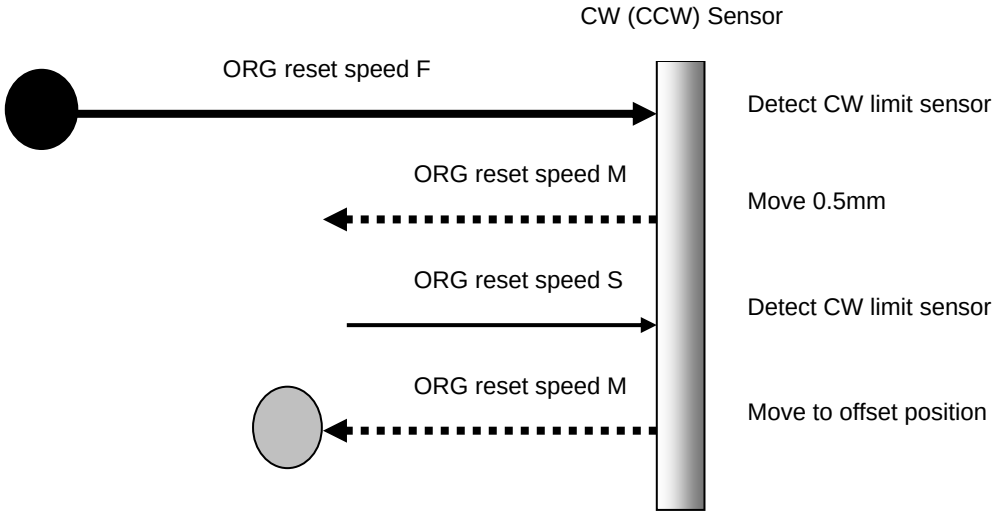
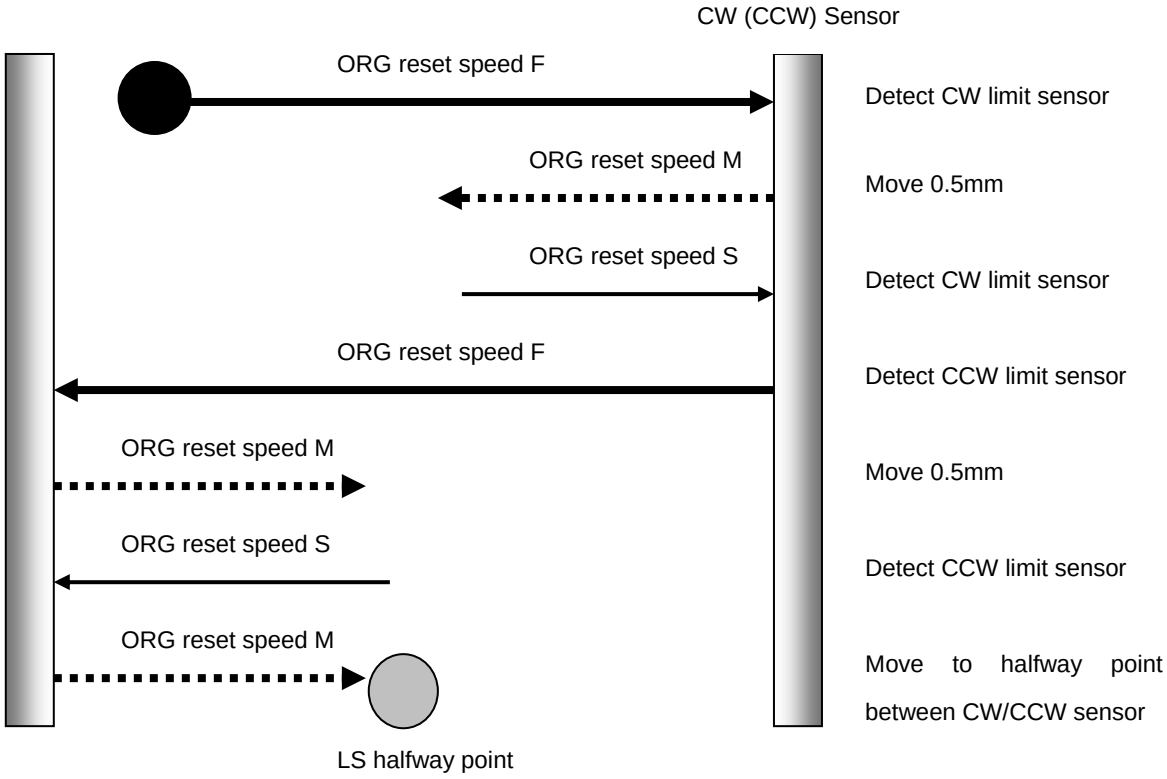
Origin Reset Method

① ORG0 Not reset ORGIN position.

② ORG1 (MINI method compatible, however stage moves to ORG offset value)



③ ORG2 (MIDDLE method)



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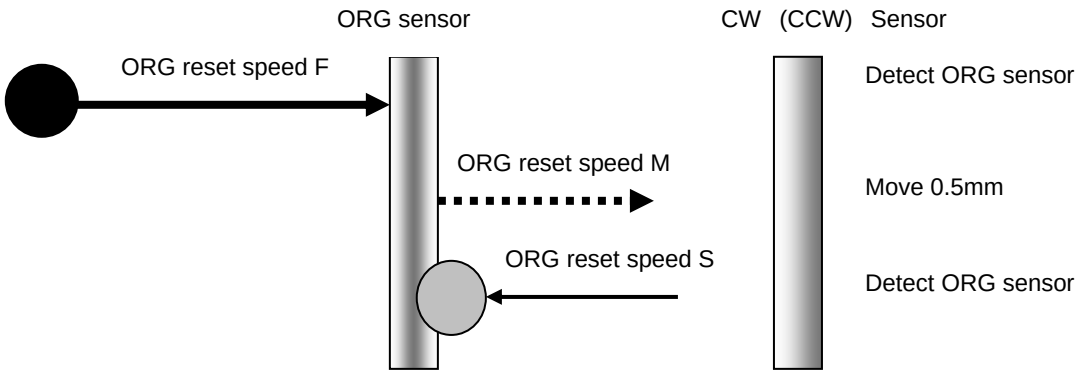
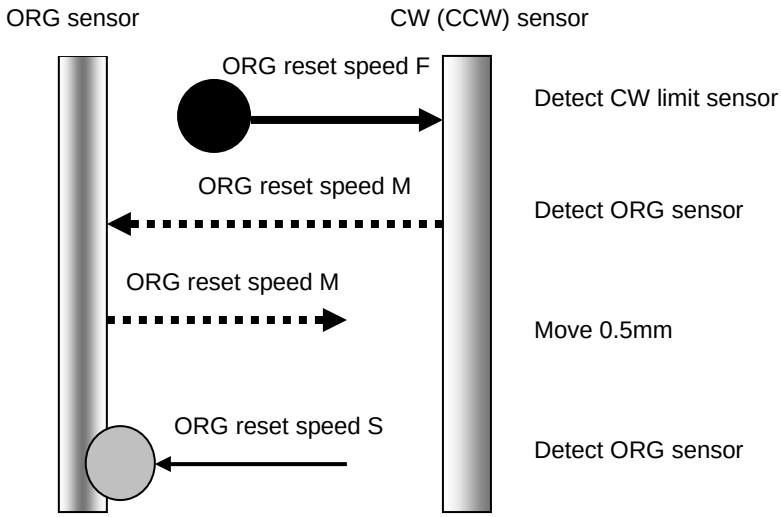
④ ORG3　(for 3 sensor use (LS + ORG))

④-1　In case that ORG sensor is set on the inside of CW(CCW) sensor



④-2　In case that ORG sensor is set beyond limit SW toward CW direction.



Caution1) In case that after detect CW (CCW) sensor, stage move toward CCW direction and then can not detect ORG sensor (in case of no ORG sensor), stage stop at CCW (CW) sensor position.

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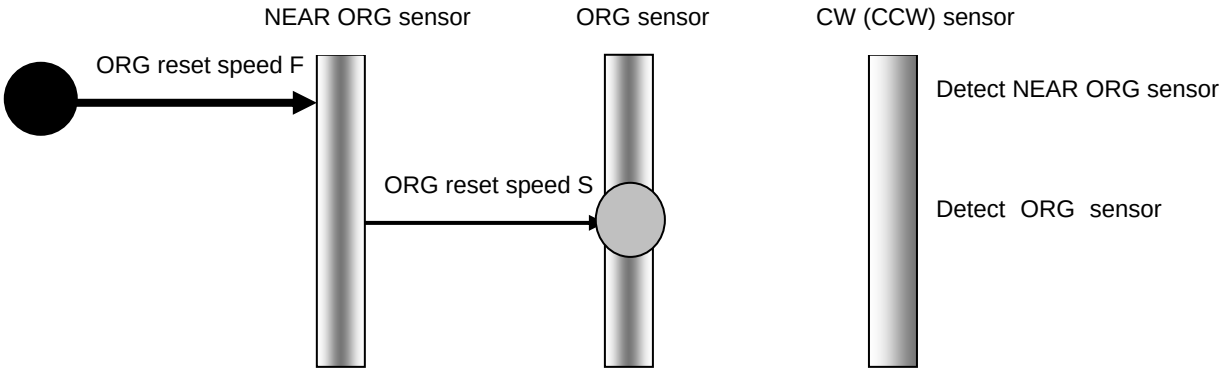
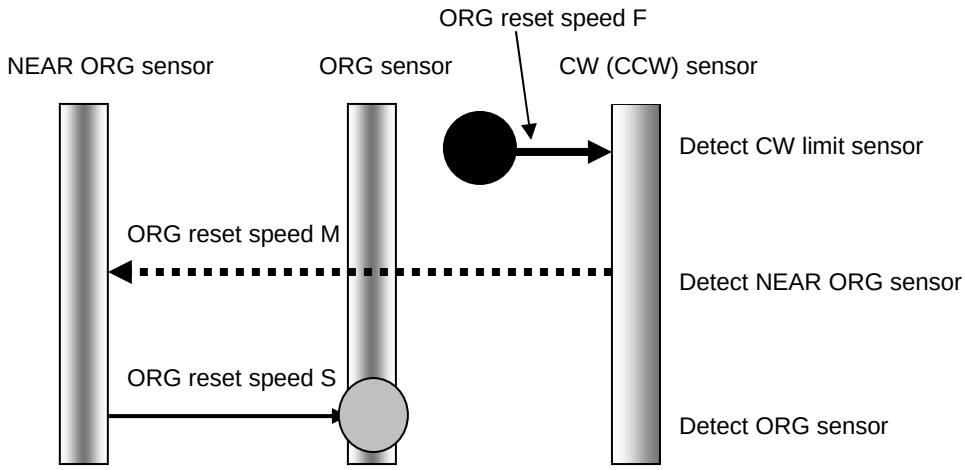
⑤ ORG4 (for 4 sensor (LS+SD+ORG) use.)

⑤-1 In case that NEAR ORG sensor is on the inside of CW(CCW) sensor.



⑤-2 In case that ORG sensor is beyond NEAR ORG sensor toward CW(CCW) direction.



Caution1) In case that after detect CW (CCW) sensor, stage move toward CCW direction and then can not detect ORG sensor (in case of no ORG sensor), stage stop at CCW (CW) sensor position.

Caution 2) In case that after detect NEAR ORG sensor, stage move toward CW direction and then can not detect ORG sensor (in case of no ORG sensor), stage stop at CW (CCW) sensor position.

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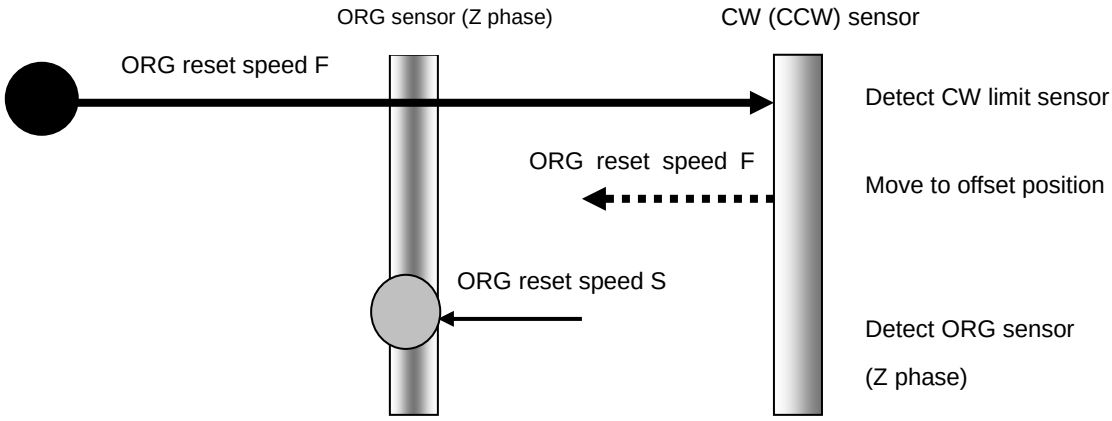
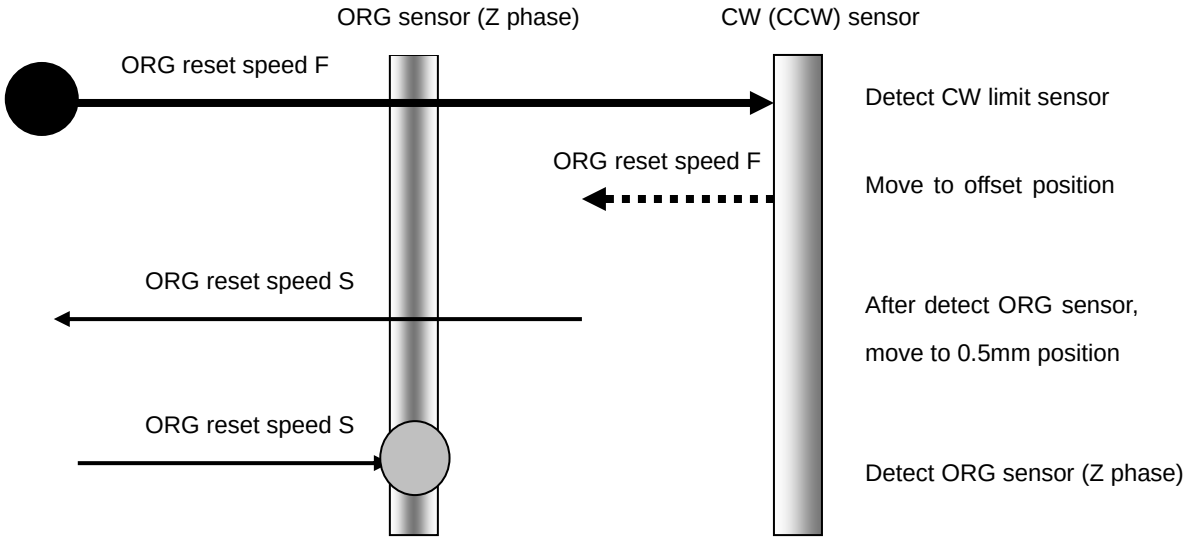
⑥ ORG5 (for 3 sensor use (LS+ORG(Z phase)))



⑦ ORG6 (for 3 sensor use (LS+ORG(Z phase)))


ORG sensor (Z phase)
CW (CCW) sensor
ORG reset speed F
Detect CW limit sensor
ORG reset speed F
Move to offset position
ORG reset speed S
After detect ORG sensor,
move to 0.5mm position
ORG reset speed S
Detect ORG sensor (Z phase)

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3-3-4 Sensor

No	Memory Switch Contents	Setting Range / Select item	Default value
1	L sensor Level0	Normal Open/Normal Close	Normal CLOSE
2	L sensor Level1	Normal Open/Normal Close	Normal CLOSE
3	L sensor Level2	Normal Open/Normal Close	Normal CLOSE
4	L sensor Level3	Normal Open/Normal Close	Normal CLOSE
5	L sensor Level4	Normal Open/Normal Close	Normal CLOSE
6	L sensor Level5	Normal Open/Normal Close	Normal CLOSE
7	L sensor Level6	Normal Open/Normal Close	Normal CLOSE
8	L sensor Level7	Normal Open/Normal Close	Normal CLOSE
9	O sensor Level0	Normal Open/Normal Close	Normal OPEN
10	O sensor Level1	Normal Open/Normal Close	Normal OPEN
11	O sensor Level2	Normal Open/Normal Close	Normal OPEN
12	O sensor Level3	Normal Open/Normal Close	Normal OPEN
13	O sensor Level4	Normal Open/Normal Close	Normal OPEN
14	O sensor Level5	Normal Open/Normal Close	Normal OPEN
15	O sensor Level6	Normal Open/Normal Close	Normal OPEN
16	O sensor Level7	Normal Open/Normal Close	Normal OPEN
17	N sensor Level0	Normal Open/Normal Close	Normal OPEN
18	N sensor Level1	Normal Open/Normal Close	Normal OPEN
19	N sensor Level2	Normal Open/Normal Close	Normal OPEN
20	N sensor Level3	Normal Open/Normal Close	Normal OPEN
21	N sensor Level4	Normal Open/Normal Close	Normal OPEN
22	N sensor Level5	Normal Open/Normal Close	Normal OPEN
23	N sensor Level6	Normal Open/Normal Close	Normal OPEN
24	N sensor Level7	Normal Open/Normal Close	Normal OPEN

1～8) L sensor Level 0～7: Limit sensor input logoc level setting (0～7axis)

Select limit sensor detecting level (Input logic level) for each axis

[Select item] Normal Open：(Normally switch ON by detecting limit sensor from SW OFF condition)

Normal Close：(Normally switch OFF by detecting limit sensor from SW ON condition)

9～16) O sensor Level 0～7: ORG sensor input logic level setting (0～7axis)

Select ORG sensor detecting level (Input logic level) for each axis.

[Select item] Normal Open：(Normally switch ON by detecting ORG sensor from OFF condition)

Normal Close：(Normally switch OFF by detecting ORG sensor from ON condition)

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17～24) N sensor Level 0～7: NEAR ORG sensor input logic level setting (0～7axis)

Select NEAR ORG sensor detecting level (Input logic level) for each axis

[Select item] Normal Open：(Normally switch ON by detecting NEAR ORG sensor from OFF condition)

Normal Close：(Normally switch OFF by detecting NEAR ORG sensor from ON condition)

3-3-5 Speed

No	Memory Switch contents	Setting Range / Select item	Default value
1	Acceleration0	Linear/S Curve	S Curve
2	Acceleration1	Linear/S Curve	S Curve
3	Acceleration2	Linear/S Curve	S Curve
4	Acceleration3	Linear/S Curve	S Curve
5	Acceleration4	Linear/S Curve	S Curve
6	Acceleration5	Linear/S Curve	S Curve
7	Acceleration6	Linear/S Curve	S Curve
8	Acceleration7	Linear/S Curve	S Curve
9	ORG0 Speed(S)	1～999999999	50000
10	ORG0 Speed(F)	1～999999999	500000
11	ORG0 Speed(R)	1～1000	200
12	ORG1 Speed(S)	1～999999999	50000
13	ORG1 Speed(F)	1～999999999	500000
14	ORG1 Speed(R)	1～1000	200
15	ORG2 Speed(S)	1～999999999	50000
16	ORG2 Speed(F)	1～999999999	500000
17	ORG2 Speed(R)	1～1000	200
18	ORG3 Speed(S)	1～999999999	50000
19	ORG3 Speed(F)	1～999999999	500000
20	ORG3 Speed(R)	1～1000	200
21	ORG4 Speed(S)	1～999999999	50000
22	ORG4 Speed(F)	1～999999999	500000
23	ORG4 Speed(R)	1～1000	200
24	ORG5 Speed(S)	1～999999999	50000
25	ORG5 Speed(F)	1～999999999	500000
26	ORG5 Speed(R)	1～1000	200
27	ORG6 Speed(S)	1～999999999	50000
28	ORG6 Speed(F)	1～999999999	500000
29	ORG6 Speed(R)	1～1000	200

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30	ORG7 Speed(S)	1～999999999	50000
31	ORG7 Speed(F)	1～999999999	500000
32	ORG7 Speed(R)	1～1000	200
33	ORG0 Speed(M)	1～999999999	250000
34	ORG1 Speed(M)	1～999999999	250000
35	ORG2 Speed(M)	1～999999999	250000
36	ORG3 Speed(M)	1～999999999	250000
37	ORG4 Speed(M)	1～999999999	250000
38	ORG5 Speed(M)	1～999999999	250000
39	ORG6 Speed(M)	1～999999999	250000
40	ORG7 Speed(M)	1～999999999	250000

1～8) Acceleration0～7: Speed –acceleration profile setting

Set speed –acceleration profile for each axis

[Select item] Linear: Trapezoidal control

S Curve: S curve control

9～40) ORG0～7 Speed(S)(F)(R)(M): ORG reset speed setting

Set mechanical ORG reset speed (minimum speed S, maximum speed F, acceleration time, medium speed M) for each axis.

[Setting Range]

S:1～500000 (Unit:pulse/s)	[SHOT mode]
S:1～999999999(Unit:0.01μm/s)	[HIT mode]
F:1～500000(Unit:pulse/s)	[SHOT mode]
F:1～999999999(Unit:0.01μm/s)	[HIT mode]
R:1～1000(Unit:ms)	[SHOT mode] [HIT mode]
M:1～999999999(Unit:0.01μm/s)	[HIT mode]
M:1～500000(Unit:pulse/s)	[SHOT mode]

*) Regarding Speed setting, minimum speed S should be set smaller than maximum speed F and medium speed M.

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3-3-6 Close

No	Memory Switch contents	Setting Range / Select item	Default value
1	CONT0	Open/Close	Open
2	CONT1	Open/Close	Open
3	CONT2	Open/Close	Open
4	CONT3	Open/Close	Open
5	CONT4	Open/Close	Open
6	CONT5	Open/Close	Open
7	CONT6	Open/Close	Open
8	CONT7	Open/Close	Open
9	INPOS0	1～99	2
10	INPOS1	1～99	2
11	INPOS2	1～99	2
12	INPOS3	1～99	2
13	INPOS4	1～99	2
14	INPOS5	1～99	2
15	INPOS6	1～99	2
16	INPOS7	1～99	2
17	RES_UNIT0	-30000～30000	100
18	RES_UNIT1	-30000～30000	100
19	RES_UNIT2	-30000～30000	100
20	RES_UNIT3	-30000～30000	100
21	RES_UNIT4	-30000～30000	100
22	RES_UNIT5	-30000～30000	100
23	RES_UNIT6	-30000～30000	100
24	RES_UNIT7	-30000～30000	100

1～8) CONT0～7: Control method setting

Set control method (Open Loop control method, Closed Loop control method) for each axis.

[Select item] Open：Open Loop control method

Close：Closed Loop control method

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9～16) INPOS 0～7: Inposition range setting

In case of Closed Loop setting condition, set Inposition renge (which is the range of stop position at stop completion) for each axis.

[Setting range] 1～99

『Point of view about INPOSITION range』

In the conition of closed loop control, a positioning of stage is completed when a reading of scale reaches inside a range of INPOS. And Setting value of 1~99 is based on 1 pulse resolution from glass scale.

*) Regarding to Scale resolution, it depends on each stage, so please refer to sensor resolution in each stage.

<Example>

In case of sensor resolution 0.01μm

Setting Value=1: INPOS range is 1×±0.01μm=±0.01μm

Setting Value=99: INPOS range is 99×±0.01μm=±0.99μm

17～24) RES_UNIT 0～7: Scale setting

Set Scale resolution and direction.

[Setting Range] -30000～30000： - input is reverse direction. Unit is nm.

Reference:

Stage	RES_UNIT
TSDM(GS)60-15(X)	-100
TSDM(GS)80-20(X)	-100
TSDM(GS)60-10ZF	100
SGSP(GS)26-50(X)	-100
SGSP(GS)26-125(X)	-100
SGSP(CS)20-85(X)	500
SGSP(CS)26-100(X)	500
SGSP(CS)26-200(X)	500

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3-4.LAN settings

LAN settings for HIT-M

① Connect PC and HIT-M using LAN.

Regarding interface between PC and LAN, please refer to「2-3 Interface with PC」.

② Activate HIT Sample.

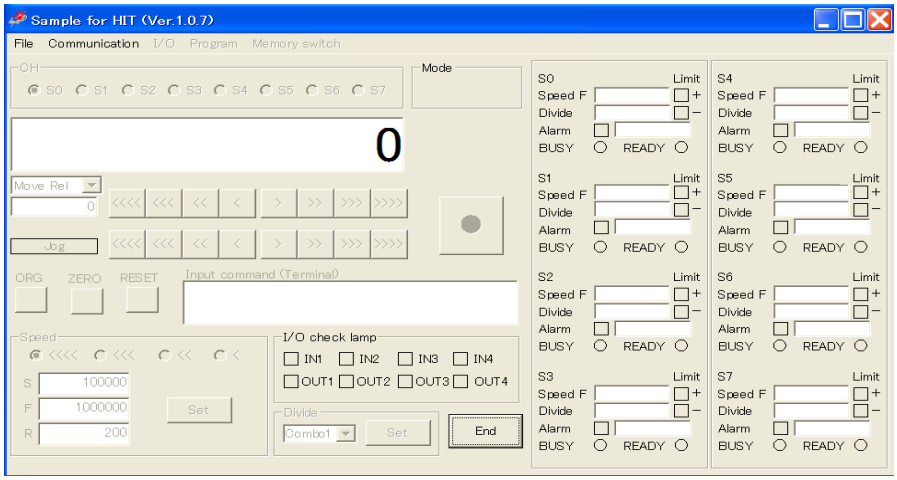

Figure 3-2：Sample software

③ Select LAN as interface from communication settings on menu bar.

④ Open communication settings (Figure 3-3) from menu bar.

Settings for HIT-M in use will also be applied to host and port.

⑤ LAN settings (Figure 3-4) will pop up by clicking'initial settings' on Communication settings (Figure 3-3).

⑥ Click OK after setting IP address on Figure 3-4 LAN settings in accordance with PC condition.

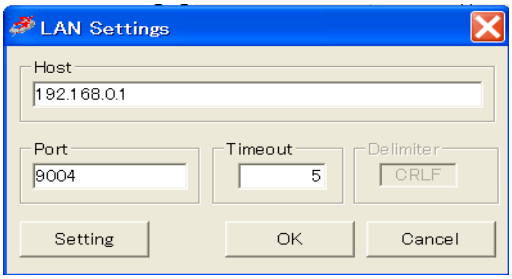

Figure 3-3：Communication settings

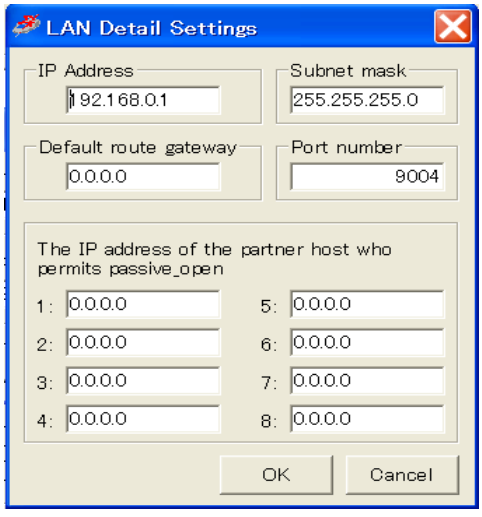

Figure 3-4：LAN settings

*) Redo PC settings according to new LAN settings when any changes have been made in settings.

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Chapter 4: Feature

4-1.HIT mode command

4-1-1 Format of HIT mode command

This mode can operate up to 8 axes.

General format is shown below. Some formats are different depending on type of command. Please refer to each command explanation for details.

code：p0,p1,p2,p3,p4,p5,p6,p7

code　Use a string to represent a command.

:　Command separation（Colon（：））

p0～p7　Use(,)command to separate and assign number of slave unit 0-7. Only integer values can be used as parameter values.

A decimal number is an incorrect command and will be responsed by NG.

+ sign can be abbreviated. +1000 or 1000 is treated as the same command.

A travel or distance parameter of 1 is equal to 0.01μm.

Parameter is abbreviated when NOP（No Operation） needs to be set to the designated slave unit number.

Note: （,）cannot be abbreviated.

（Ex） ,,p2,p3,p4,p5,,p7　Parameter of slave unit 0 and 1 is abbreviated.

p0,,p2,p3,p4,p5,,p7　Parameter of slave unit 1 and 6 is abbreviated.

p0,p1　Parameter of slave unit after 2 is abbreviated.

Capital or lower case characters can used. Example: h and H are both valid for the Home command.

Backspace is effective to delete a prior string.

Command string must not have leading or trailing spaces. Otherwise, the command string will not be accepted and NG will be returned as a command error.

Immediate movement will be made in case when activation commands such as H, M, A, E, K, and J commands are accepted normally. Unlike the SHOT mode, the activation command (G) is not needed in HIT mode. Activation command (G) is treated as an incorrect command in HIT mode.

When issuing Q, ?, !, or I command, its status will be responded. In case which other commands are issued, ‘OK’ or ‘NG’ sign will be responded. ‘OK’ and ‘NG’ signs hereby mean ‘normal acceptance’ and ‘acceptance refused for an incorrect command’ respectively. When other commands except Q, ?, L, !, I, O commands are issued to an engaged slave in busy condition, ‘NG’ sign will be responded for incorrect commands, which will result in the whole command not being executed.

When commands are issued to a disconnected slave, the command parameter of disconnected slave will be disregarded, however, commands to the other slaves will be executed normally.

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4.1.1 Command list

Command	Movement	Detail
H	Return to mechanical origin	Detect mechanical origin
M	Set number of pulses for relative movement	Setting of Axis of movement, direction, number of pulses with relative coordinate
A	Set number of pulses for absolute movement	Setting of Axis of movement, direction, number of pulses with absolute coordinate
E	Settings of rotary movement	Circular interpolation (Move at minimum speed (S))
K	Settings of linear interpolation movement	Linear interpolation (Move at minimum speed (S))
J	Jog command	Move by minimum speed (S)
L	Stop	Stop or reduce speed
R	Set electronic (logical) origin	Set the electronic (logical) origin to the current position
D	Speed settings	Set S, F, and R of M and A command
C	Free motor	Excitation ON/OFF
S	Switch number of steps	Switch number of steps (Full step at 0.72°)
Q	Status1	Return current position etc.
!	Status2	Return 1(Busy) or 0 (READY)
?	Internal information	Return by internal information
O	I/O output command	Output data to OUT terminal of I/O connector
I	I/O input check	Return data to IN terminal of I/O connector
P	Program control	Internal program command
B	Setting of returning origin speed	Setting of returning origin command (S, F, R and M)
Z	Mode change	Switching to SHOT mode or HIT mode

Close loop control works when “**A**” or “**M**” command is operated and scale is applied to position the stage inside a range of INPOS. During operation of close loop control, a return of position information by Q command is a scale number.

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4-1-2 H command (Return to mechanical origin command)

(1) Function

This command indicates detect the mechanical origin for a stage and set the position as the origin. Coordinate value is cleared by 0.

When the designated slave number with parameter is 1, the mechanical origin will be operated. No operation to 0 or abbreviated slave unit.

(2) Example

H:1,1,0 means to operate the mechanical origin to slave number 0 and 1

4-1-3 M command (Relative movementl command)

(1) Function

This command indicates relative movement with pulse number.

Travel is a length and indicates by (0.01μm unit)

*) Controller enables to output number of pulse (-134217728 to +134217727). In case of the over number, NG will be returned and stage will not move.

(**Note:** The above limitation is conflicted when a high microstep is set.)

When close loop is set, a positioning is completed when a reading of scale reaches inside a range of INPOS.

(2) Example

M:,100000,-20000,,30000 means to move from current position 1mm, -0.2mm and 0.3mm to slave number 1, 2 and 4 respectively.

4-1-4 A command (Absolute movement command)

(1) Function

This command indicates Relative movement with pulse number.

Travel is a length and indicates by (0.01μm unit)

*) Controller enables to output number of pulse (-134217728 to +134217727). In case of the over number, NG will be returned and stage will not move. Actual length of travel is calculated automatically by controller from a specified absolute movement length value.

(**Note:** The above limitation is conflicted when a high microstep is set.)

In the conition of closed loop control, a positioning of stage is completed when a reading of scale reaches inside a range of INPOS.

(2) Example

A:, 0,-20000,,30000 means to return to origin (0), -0.2mm and 0.3mm of absolute position to slave number 1, 2 and 4 respectively.

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4-1-5 E command (Arc interpolation movement command)

(1) Function

This command for arc interpolation movement enables to specify operation axis and rotation direction. 3 different modes of parameter are available to operate the arc interpolation movement with arbitrary 2 axes.

When this command is sent under condition of busy and unconnected of slave unit, it will be responsed by NG as a command error and all command will stop to operate.

To operate an interpolation with this command, a designation of (S shape drive / trapezoidal shape drive) and pulse speed and travel per pulse must be identical for both axes.

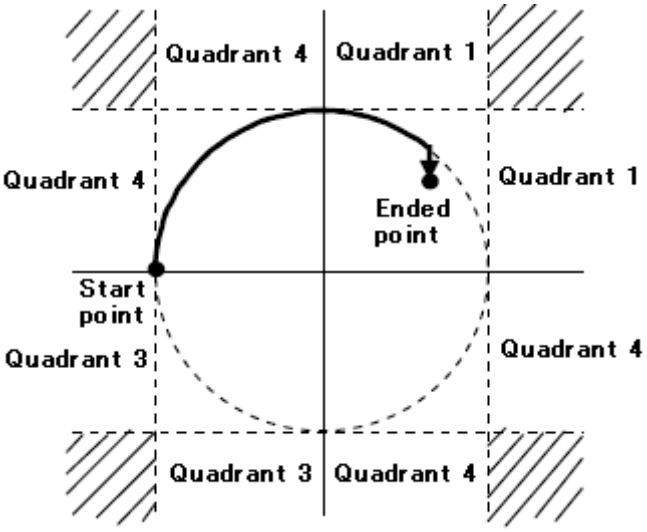
Otherwise, an interpolation movement will be unable to operate due to an incorrect setting.

Note: if there is a difference in Base rate between slave units, apparent speed ([S, F, R value] and [Microstep] and [Acceleration and Deceleration] pattern (Trapezoidal shape or S shape)) is same, pulse speed and travel per pulse are different. However the speed when operates the arc interpolation movement is minimum speed (S).

Coordinate of arc movement is specified based on the relative travel from current position (0.01μm unit).

E：0 command (Arc interpolation movement command 0) is a setting for the end of Coordinate. In order to move out from a circular line as shown by the image right hand side, the end movement of one axis when it reaches to a specified position in a quadrant and stop the interpolation function. Then, another axis move to reach the end point.

Note: the specified end point as ended coordinate of arc interpolation inside the area of diagonal line, the stage will move non-stop and arc interpolation movement is effective without end.



Due to operation by calculation, there is a calculation error to the ended point of **E：1 command** (Arc interpolation movement command 1) and **E：2command** (Arc interpolation movement command 2). Please check the actual stage.

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4-1-5-1 E:0 command (Arc interpolation movement ommand０)

(1) Function

This command indicates a designation of ended point and center point in order to operate the arc movement.

(2) Example

E：0,axis0,axis1,d,e0,e1,c0,c1

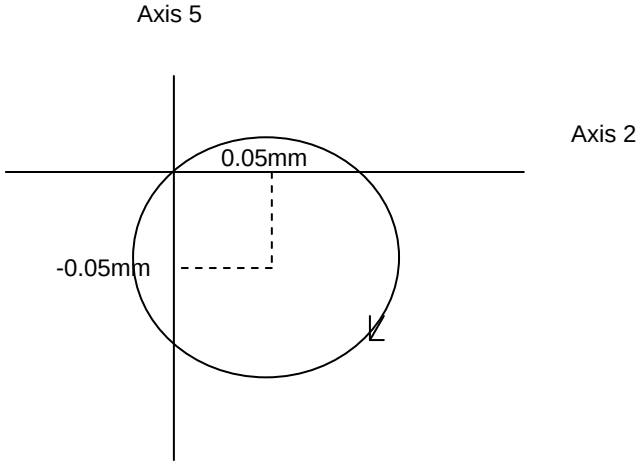
axis0, axis1：0～7 means to designate the number of slave unit to operate arc interpolation movement. Same number of slave unit or unconnect is prohibited. Axis 0 represents X axis andaxis 1 represents Y axis.

d：0 or 1 0 is CW rotation (Clockwise), 1 is CCW rotation (Counterclockwise)

e：Ended point coordinate (e0 axis0 setting value、e1 axis1 setting value) (unit of setting 0.01μm unit)

c：Center point coordinate (c0 axis0 setting value、c1 axis1 setting value) (unit of setting 0.01μm unit)

E：0,2,5,0,0,0,5000,-5000 A center point coordinate is based on a relative coordinate of the current position (0.05mm,-0.05mm) and move stages of slave unit No2, Slave unit No5 one round clockwise until the current position.



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4-1-5-2 E：1 command　(Arc interpolation movement command 1)

(1) Function

This command indicates a designation of center point and degree of ended point in order to operate the arc movement

(2) Example

E：1, axis0,axis1,d,c0,c1,ae

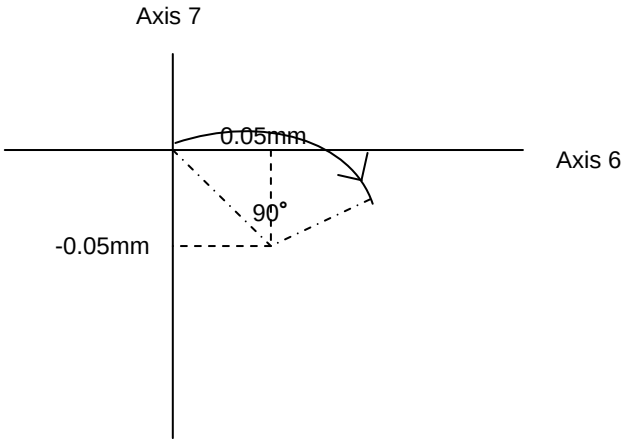
axis0, axis1：0～7 means to designate the number of slave unit to operate arc interpolation movement. Same number of slave unit or unconnect is prohibited. Axis 0 represents X axis and axis 1 represents Y axis.

d：0 or 1 0 is CW rotation(Clockwise). 1 is CCW rotation (Counterclockwise).

c：Center point coordinate (c0 axis0 setting value、c1 axis1 setting value)
(unit of setting 0.01μm unit)

ae：Degree of ended point (deg) (Setting range：integer of 0°<ae≦360° The other degree than mentioned is NG.)

E：1,6,7,0,5000,-5000,90 A center point coordinate is based on a relative coordinate of the current position (0.05mm,-0.05mm) and move stages of slave unit No6、Slave unit No7 90°from current position to degree of ended point position clockwise.



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4-1-5-3 E：2 command　(Arc interpolation movement command 2)

(1) Function

This command indicates a designation of pass point coordinate and ended point's coordinate in order to opearate the arc interpolation movement. Note: if 3 points (current position, pass point coordinate and ended point coordinate) lay on the same straight line, it is unable to make an arc movement.

(2) Example

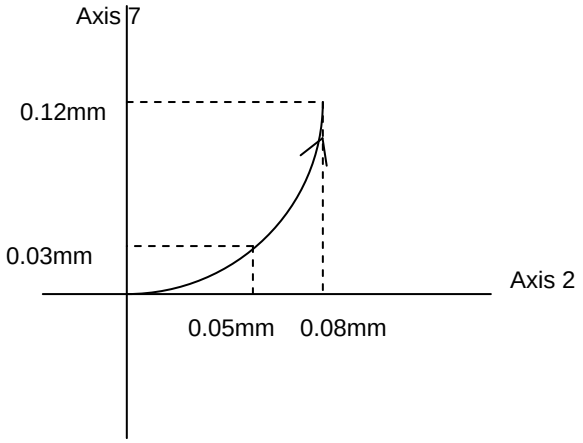
E：2, axis0,axis1,p0,p1,e0,e1

axis0, axis1：0～7　means to designate the number of slave unit to operate arc interpolation movement. Same number of slave unit or unconnect is prohibited. Axis 1 represents X axis and axis 2 represents Y axis.

p：Pass point coordinate　(p0 axis0 setting value、p1 axis1 setting value)
(unit of setting 0.01μm unit)

e：Ended point coordinate　(e0 axis1 setting value、e1 axis1 setting value)
(unit of setting 0.01μm unit)

E：2,2,7,5000,3000,8000,12000　Pass point coordinate and ended point coordinate are based on a relative coordinate of the current position (+0.05mm, +0.03mm) and (+0.08mm, +0.12mm). Then, stages of slave unit No2、Slave unit No5 move circularly.



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4-1-6 K command (Linear interpolation movement command)

(1) Function

This command indicates a designation of axis of movement and a designation of relative movement in order to operate linear interpolation movement. Operation of linear interpolation movement is able to designate up to arbitrary 3 axes.

When this command is sent under condition of busy and unconnected of slave unit, it will be responsed by NG as a command error and all command will stop to operate.

To operate an interpolation with this command, a designation of (S shape drive / trapezoidal shape drive) and pulse speed and travel per pulse must be identical for both axes.

Otherwise, an interpolation movement will be unable to operate due to an incorrect setting.

Note: if there is a difference in Base rate between slave units, apparent speed ([S, F, R value] and [Microstep] and [Acceleration and Deceleration pattern (Trapezoidal shape or S shape)) is same, pulse speed and travel per pulse are different.

Coordinate of linear movement is specified based on the relative travel from current position (0.01μm unit).

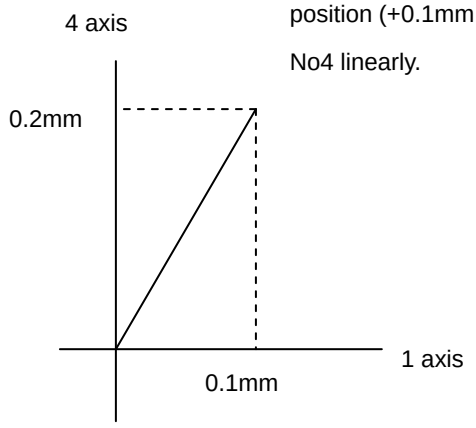
(2) Example

K：axis0,axis1, axis2,e0,e1,e2

axis0,axis1,axis2：0～7 means to designate the number of slave unit to operate linear interpolation movement. Same number of slave unit or unconnect is prohibited. To operate linear interpolation movement by 2 axes, please abbreviate axis2.

e:Ended point coordinate (e0 axis0 setting value、e1 axis1 setting value、e2 axis2 setting value) To operate linear interpolation movement by 2 axes, please abbreviate axis2. (unit of setting 0.01μm unit)

K：1,4,,+10000,20000 Ended point coordinate is based on a relative coordinate of the current position (+0.1mm, +0.2mm) and move stages of slave unit No1、Slave unit No4 linearly.



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4-1-7 J command　(Jog command)

(1) Function

This command indicates to drives stages continuously (at a constant speed) at the minimum pulse speed (S). During command operation, stage will move non-stop until the detection of limit sensor or receipt of Stop command (L command).

(2) Example

J：s0,s1,s2,s3,s4,s5,s6,s7

s：+,- or abbreviated　　+ is + direction, - is - direction、abbreviated is NOP(No Operation).

J：,+,,,,-,+,-　　Jog movement to Slave unit No1 is + direction, Slave unit No5 is － direction, Slave unit No6 is + direction, Slave unit No7 is － direction. No movement to Slave unit No0、2-4.

4-1-8 L command　(Decelerate and stop command)

(1) Function

Deceleration and stop stage

(2) Example

L：p0,p1,p2,p3,p4,p5,p6,p7

p：0,1 or abbreviated　　1 is to decelerate and stop stage of the slave unit number.　0 or abbreviated are NOP(No Operation).

L：,,1,1　　To decelerate and stop stage of the slave unit No2 and 3.

4-1-9 L:E command　(Emergency stop (Immediate stop) command)

(1) Function

This command indicates to stop stages of all slave units immediately.

(2) Example

L：E　　means to stop stages of all slave units immediately.

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4-1-10 R command　(Return to logical origin command)

(1) Function

This command indicates a setting of logical origin (coordinate value 0) to the stage of the designated slave unit number based on the current position.

When this command is sent under condition of busy and unconnected of slave unit, it will be responsed by NG as a command error and all command will stop to operate.

(2) Example

R：p0,p1,p2,p3,p4,p5,p6,p7

p：0,1 or abbreviated　1 is to set the logical origin to the stage of the slave unit number. 0 or abbreviated are NOP(No Operation)

R：,,1,1　means to set the logical origin (coordinate value 0) to the stage of the slave unit number 2 and 3.

4-1-11 D command　(Speed setting command)

(1) Function

This command indicates a speed setting to the designated slave unit number. It is unable to set the multiple number of slave unit at the same time.

When this command is sent under busy condition of slave unit, it will be responsed by NG as a command error and all command will stop to operate.

(2) Example

D : axis,s,f,r

axis： Slave unit number　0～7

s： Start-up speed (Initial speed)　range of setting: 1～999999999 (unit : 0.01μm/s)

f： Maximum speed　range of setting: 1～999999999 (unit : 0.01μm/s)

r： Acceleration / deceleration time　range of setting:1～1000 (unit : ms)

Note : the condition of s<=f

*) Maximum speed (calculated by pulse) is 800000(pulse/s). In case of over speed setting (travel : 0.01μm/s unit), OK will be returned, but it will be treated as speed of 800000(pulse/s).

D : 5,10000,100000,200　means Start-up speed : 0.1mm/s, 1mm/s : Maximum speed, 200ms : Acceleration / deceleration time to slave unit No5.

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4-1-12 C command　(Excitation On/OFF command)

(1) Function

This command indicates an Excitation On/OFF of motor. The stage is able to move (rotate) manually when the excitation OFF of motor.

When this command is sent under busy condition of slave unit, it will be responsed by NG as a command error and all command will stop to operate.

(2) Example

C：p0,p1,p2,p3,p4,p5,p6,p7

p：0,1 or abbreviated　1 is an Excitation ON to the stage of the slave unit number. 0 is an Excitation OFF to the stage of the slave unit number. The abbreviation is NOP（No Operation）

C：,,1,0　Excitation ON to the motor of the slave　unit No2, and OFF to motor of slave unit No3.

4-1-13 S command　(Setting microstep command)

(1) Function

This command indicates to change motor step angle (microstep).

The number of microstep can be set by 15 types. Other numbers except mentioned below cannot be set.

1, 2, 4, 5, 8, 10, 20, 25, 40, 50, 80, 100, 125, 200, 250

Division	1	2	4	5	8	10	20	25	40	50	80	100	125	200	250
Step angle	0.72	0.36	0.18	0.144	0.09	0.072	0.036	0.0288	0.018	0.0144	0.009	0.0072	0.00576	0.0036	0.00288
Pulse number per 1 rotation	500	1000	2000	2500	4000	5000	10000	12500	20000	25000	40000	50000	62500	100000	125000
Resolution (μm)	2	1	0.5	0.4	0.25	0.2	0.1	0.08	0.05	0.04	0.025	0.02	0.016	0.01	0.008

When this command is sent under busy condition of slave unit, it will be responsed by NG as a command error and all command will stop to operate.

※) At Closed Loop control method, similar other than Original position, and do not carry out S command. When similar other than Original position and change motor step angle, because a coordinate position changes, work definitely and not carried out.

(2) Example

S：d0,d1,d2,d3,d4,d5,d6,d7

d：　means to input the command with the above 15 types of number or abbreviation to set　the number of step angle to the designated slave unit number.

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The abbreviation is NOP（No Operation）.

S : 20, 40 Setting Division of 20 and 40 to Slave No0,1.

4-1-14 Q command (Reading current position command)

(1) Function

This command indicates to return the current position information of 8 stages of slave. unit No 0-7 (0.01μm unit). The returned current position data is separated by (,) -mark represents when the current position is minus. Maximum 10 digit including marking by left-align display.

(2) Example

Q :

-1000,1000,100,,,,0,0 Return data : current position of slave unit No0 is -0.01mm, 0.01mm to slave unit No1, 0.001mm to slave unit No2, no connection for slave unit No3-5, and 0mm to slave unit No6-7.

4-1-15 Q command (Reading status command)

(1) Function

This command indicates to return the status information of master and slave unit No0-7.

The returned data is separated by (,).

The status of the unconnected of slave unit No is abbreviated and display only (,).

(2) Example

Q : S

stm,sts0,sts1,sts2,sts3,sts4,sts5,sts6,sts7

stm 00： Master accepted the received command.

01： Master rejected the received command due to wrong command.

Sts 00～FF： Return the status of the slave unit No with hexadecimal number and 2 digit. Each bit of Hexadecimal number and status are shown as table below. A bit represented by 0 means undetected and 1 means detected.

7	6	5	4	3	2	1	0
-	DRV alarm	Scale alarm	Z limit	Near	ORG	+LS	-LS
-	0 or 1	0 or 1	0 or 1	0 or 1	0 or 1	0 or 1	0 or 1

Example of returned data

00,01,02,,,,,,01 means master accepted the received command. Detect –LS by Slave unit No0 and 7, detect +LS by Slave unit No1 and Unconnected status by slave unit No2-6.

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4-1-16 ! command　(Reading status command)

(1) Function

This command indicates to return the status (Busy/Ready) of each slave unit.

(2) Example

！：

sts0, sts1, sts2 ,sts3, sts4, sts5, sts6, sts7　　Returned data

sts　0 means the ready status of the slave unit. 1 represents the busy status of the slave unit. Abbreviation represents unconnected.

Example of returned data

1,0,,,,,,0　　means the ready status of slave unit No1 and 7, Busy status of slave unit No0 and unconnected status of slave unit No2 and 6.

4-1-17 ? command　《Reading internal information command》

(1) Feature

This command indicates to return controller information.

(2) Example

？：Paxis

P　above represents by string parameter is shown as table below.

axis　above represents slave unit number. Note: slave unit No0-7 must be written only when D or B string parameter is applied.

String parameter	Returned data	Example of returned data
N	Device name	HIT-M
V	Version	V1.00-001
Z	Mode	0　(SHOT_MODE) 1　(HIT_MODE)
P	Travel per pulse (μm)	1.00,2.00,1.00,2.00,,,,
S	Microstep	2,2,20,10,,,,
D	Travel speed	1000,500000,100
B	Returning origin speed	1000,500000,100,200000
L	Status of program operation	ProgNo、ProgRun、LineNo、Count of remaining Loop (Example)2,1,13,4 13 row of program No.2 is running and count of remaining Loop is 4.

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4-1-18 O command （Output data command）

(1) Function

This command indicates output the data to the output terminal of I/O connector (4 bit).

Output	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
OUT1	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON
OUT2	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON
OUT3	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF	OFF	OFF	ON	ON	ON	ON
OUT4	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON

(2) Example O：14

4-1-19 I command （Input data command）

(1) Function

This command indicates iput the data to the input terminal of I/O connector (4 bit).

Data	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
IN1	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON
IN2	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON
IN3	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF	OFF	OFF	ON	ON	ON	ON
IN4	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON

(2) Example

I： Returned data **14**

4-1-20 P command （Internal program control command）

(1) Function

This command indicates program number selection of internal program and Operate/Stop. Please refer to the detail of program feature from “4-3 program feature”.

(2) Example

P：p

p：P, S, E, U0, U1

P：Pn n represents program number which can be selected 0-9. The others than mentioned will be responsed by NG as a command error. It is 0 when power on. **(Example) P:P2** Program No.2 is selected.

S： Start operation of the program. Start operation of the selecting program. **(Example) P：S**

E： Finish program operation. When the finish command is accepted, it will finish the under operating in the current Line No.**（Example）P：E**

U0： Stop program temporarily. When the the command is accepted, it will temporarily stop after the under operating program in the current Line No.

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(Example)P：U0

U1： Restart program. The temporary stop of program can be restarted by P：U0.

(Example)P:U1

4-1-21 B command (Setting of returning origin speed command)

(1) Function

This command indicates the setting of returning origin speed to the designated slave unit number. It is unable to set the multiple number of slave unit at the same time. When this command is sent under condition of busy and unconnected of slave unit, it will be responsed by NG as a command error and all command will stop to operate.

(2) Example

B：axis,s,f,r,m

axis： Slave unit No.0～7

s： Start-up speed (Initial speed) range of setting: 1-999999999 (unit : 0.01μm/s)

f： Maximum speed range of setting: 1-999999999 (unit : 0.01μm/s)

r： Acceleration/deceleration time range of setting:1-1000 (unit : ms)

m： Intermediate speed range of setting: 1-999999999 (unit : 0.01μm/s)

Note : the condition of s≦m≦f

*) Maximum speed (calculated by pulse) is 800000(pulse/s). In case of over speed setting (travel : 0.01μm/s unit), OK will be returned, but it will be treated as speed of 800000(pulse/s).

B:5,10000,100000,200,50000 Setting start-up speed by 0.1mm/s, Maximum speed by 1mm/s, Acceleration/deceleration time by 200m and Intermediate speed by 0.5mm/s to slave unit No5.

4-1-22 Z command (Mode change command)

(1) Function

This command indicates the change of mode (HIT mode or SHOT mode).

There are significant different in command format and parameter meaning (travel/pulse) between HIT mode and SHOT mode. Do not change the mode during under program operation. The change of mode must be done after setting the initial value.

(2) Example

Z：p

p： 0 represents SHOT mode and 1 represents HIT mode.

Z：0 Changed to SHOT mode

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4-2.SHOT mode command

4-2-1 Format of SHOT mode command

This mode follows a specific pattern of SIGMA-KOKI SHOT controller for 5 phase motor stage. Therefor, there are not available to use more than 4 axes stages in this mode.

Followings are the general format. But, please refer each command details as there may be a little different point in some commands.

code：axis±Pnum±Pnum±Pnum±Pnum

+/- Pnum is able to specify and set from 1 to 4. In case of multipul axes, this should be set W.

+/- Pnum is applied 1 to 4 (Slave number is 0 to 4) in order from the left.

code Use a string to represent a command.

： Command separation(Colon(**：**))

Axis 1 to 4 (Slave number is 0 to 4) or W (In case of multiple number setting)

- In SHOT mode, please note that the axis number is one more than the slave number as above.

±	Specify the movement direction
P	delimiter letter to moveing distance
num	Spexcify the moving distance by puls numbers. However, in case of M and A commands in closed loop it is specified the distance asmicrons. This value should not be decimal. If it is decimal, it will be returned NG due to devious command.

Capital or lower case characters can used. Example: h and H are both valid for the Home command.

Backspace is available to delete one character adjacent.

Command string must not have leading or trailing spaces. Otherwise, the command string will not be accepted and NG will be returned as a command error.

If commands which are Q, ?, !, I are issued, correspondent status will be retured.

In case of other commands, it will be returned OK (correct acceptance) or NG (Reject cceptance due to devious commands)

In case of command use like drive commands which are M, A, E, K and J except H, it needs to be activate command (G).

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4-2-1 Command list

Command	Movement	Detail
H	Return to mechanical origin	Detect mechanical origin
M	Set number of pulses for relative movement	Setting of Axis of movement, direction, number of pulses with relative coordinate
A	Set number of pulses for absolute movement	Setting of Axis of movement, direction, number of pulses with absolute coordinate
E	Settings of rotary movement	Circular interpolation (Move at minimum speed (S))
K	Settings of linear interpolation movement	Linear interpolation(Move at minimum speed (S))
J	Jog command	Move by minimum speed (S)
G	Execute command for moving	Start to move
L	Stop	Stop or reduce speed
R	Set electronic (logical) origin	Set the electronic (logical) origin to the current position
D	Speed settings	Set S, F, and R of M and A command
C	Free motor	Excitation ON/OFF
S	Switch number of steps	Switch number of steps (Full step at 0.72°)
Q	Status1	Return current position etc.
!	Status2	Return 1(Busy) or 0 (READY)
?	Internal information	Return by internal information
O	I/O output command	Output data to OUT terminal of I/O connector
I	I/O input check	Return data to IN terminal of I/O connector
P	Program control	Internal program command
B	Setting of returning origin speed	Setting of returning origin command (S, F, R and M)
Z	Mode change	Switching to SHOT mode or HIT mode

Close loop control works when "**A**" or "**M**" command is operated and scale is applied to position the stage inside a range of INPOS. During operation of close loop control, a return of position information by Q command is a scale number.

If command in busy condition except Q、?、L、!、I、Q command is issued, it return NG as malformed command and not execute the command.

If the command is issued to unconnected slave, command parameter of unconnected slave is ignored and command parameter to the other slave will execute normally.

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4-2-2 H command (Return to mechanical origin)

(1) Function

Detect mechanical origin and set the position Origin. The coordinate value will be cleared.

(2) Example

H:1	Detect the mechanical origin for the first axis (Slave No.0).
H:4	Detect the mechanical origin for the second axis (Slave No.3).
H:W	Detect the mechanical origin for the first to 4th axis (Slave No.0 to 3).

4-2-3 M command: Set number of pulses for relative travel

(1) Function

This command is to specify the axis of travel, direction, and the travel (number of pulses). This command must always be followed by a drive (G) command. Travel is by means of acceleration/deceleration driving. The distance traveled is specified in pulses.

OPEN and CLOSED LOOP is able to be specified by each axis. In case of closed loop control, positioning is completed within the range of INPOS after reading scale.

(2) Example

M:1－P100 G:	Travel 100 pulses in the - direction on the first axis (In open) Travel 1000 microns in the - direction on the first axis (In closed loop)
M:4－P100 G:	Travel 100 pulses in the - direction on the 4th axis(Slave No.3) (In open) Travel 100 microns in the - direction on the 4th axis(Slave No.3) (In closed loop)
M:W+P100-P50+ P150-P200 G:	Travel 100 pulses in the + direction on the 1st axis, 50 pulses in the –direction on the 2nd, 150 pulses in the + direction on the 3rd axis and 200 pulses in the - direction on the 4th axis. (In open) Travel 100 microns in the + direction on the 1st axis, 50 microns in the –direction on the 2nd, 150 microns in the + direction on the 3rd axis and 200 microns in the - direction on the 4th axis. (In closed loop)
M:W+P100-P50+ P0-P200 G:	Travel 100 pulses in the + direction on the 1st axis, 50 pulses in the –direction on the 2nd, not move on the 3rd axis and 200 pulses in the - direction on the 4th axis. (In open) Travel 100 microns in the + direction on the 1st axis, 50 microns in the –direction on the 2nd, not move on the 3rd axis and 200 microns in the - direction on the 4th axis. (In closed loop)

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4-2-4 A command　(Absolute movement command)

(1) Function

This command is to specify the axis of travel, direction, and the travel distance (number of pulses). This command must always be followed by a drive (G) command. Travel is by means of acceleration/deceleration driving.

The distance travel is specified in pulses in Open and in micron in Closed loop.

Open and Closed loop is able to be specified by each axis. In case of closed loop control, positioning is completed within the range of INPOS after reading scale.

(2) Example

A:1－P100 G:	Travel 100 pulses in the -direction on the first axis (In open) Travel 100 micron in the -direction on the first axis (In closed loop)
A:4－P100 G:	Travel 100 pulses in the - direction on the 4th axis(Slave No.3) (In open) Travel 100 microns in the - direction on the 4th axis(Slave No.3) (In closed loop)
A:W+P100-P50+P150-P200 G:	Travel 100 pulses in the + direction on the 1st axis, 50 pulses in the –direction on the 2nd, 150 pulses in the + direction on the 3rd axis and 200 pulses in the - direction on the 4th axis. (In open) Travel 100 microns in the + direction on the 1st axis, 50 microns in the –direction on the 2nd, 150 microns in the + direction on the 3rd axis and 200 microns in the - direction on the 4th axis. (In closed loop)
A:W+P100-P50+P0-P200 G:	Travel 100 pulses in the + direction on the 1st axis, 50 pulses in the –direction on the 2nd, move to electrical (logical) ORIGIN on the 3rd axis and 200 pulses in the - direction on the 4th axis. (In open) Travel 100 microns in the + direction on the 1st axis, 50 microns in the –direction on the 2nd, move to electrical (logical) ORIGIN on the 3rd axis and 200 microns in the - direction on the 4th axis. (In closed loop)

4-2-5 E Command　（Arc interpolation movement command）

(1) Function

Set final / central coordinates for execution of arc interpolation to relative coordinates (pulse rate) against current position. Activation command (G:) is necessary after execution of this command.

Rotation is made clockwise at all times.

The axis which executes arc interpolation is available in setting only between axis 1(slave no.0) and axis 2 (slave no.1) and not applicable to the alterations.

The speed of axis 1 & 2（S,F,R）, travel per pulse and acceleration / deceleration speed formula (between trapezoidal shape and S shape) need to be set to same values on two different axes.

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However, travel speed is set to speed S for arc interpolation.

(2) Example

E:W+P0+P0+P5000+P0 G: Final coordinates Central coordinates	Travel clockwise like drawing a circle against the relative center of 5000 pulse position on the first axis as X and the 0 pulse position on the second axis as Y, and then stop at the current position.

Final coordinates are to be assigned in command E. However, in case when the circular arc is dislocated as shown in the right figure, interpolation operation terminates at the position where the other axis reaches final position with final quadrant, then it travels to final coordinates.

Please note that it cannot be terminated and the operation will continue permanently., when diagonal line in the right figure has been set to final coordinates of arc interpolation,

4-2-6 K Command （Linear interpolation command）

(1) Function

Set final coordinates for execution of linear interpolation to relative coordinates (pulse rate) against current position. Activation command (G:) is necessary after execution of this command.

The axis which executes linear interpolation is available in setting only between axis 1(slave no.0) and axis 2 (slave no.1) and not applicable to the alterations. Due to the fact that activation will be processed with speed, the speed of axis 1&2 （S,F,R）, travel per pulse and acceleration / deceleration speed formula (between trapezoidal shape and S shape) need to be set to same values on 2 different axes.

(2) Example

E:W+P1000+P500 G: Final coordinates	Travel using linear interpolation to the 1000 pulse position on the first axis and the 500 pulse position on the second axis.

4-2-7 J Command （Jog movement command）

(1) Function

This command is to continue the movement with start-up speed (S speed). Activation command (G:) is necessary after execution of this command.

(2) Example

J:1+ G:	Travel axis 1 toward '+' direction with S speed.
J:4- G:	Travel axis 4 toward '-' direction with S speed.
J:W+--+ G:	Travel axis 1 toward '+'direction, 2 toward '-', 3 toward '-', and 4 toward '+', with S speed.

4-2-8 G Command （Activation command）

(1) Function

After the M, A, E, K and J commands, G command is needed to activate the stage .

4-2-9 R Command （Electrical (logical) origin settings command）

(1) Function

Clear the coordinate value by setting current position of the stage to coordinate origin.

(2) Example

R:1	Set current position on axis 1 to coordinate origin.
R:4	Set current position on axis 4 to coordinate origin.
R:W	Set current position on axis 1 to 4 to coordinate origin.

4-2-10 L Command （Deceleration stop command）

(1) Function

It decelerates and terminates designated axis (stage).

(2) Example

L:1	Decelerate axis 1 until it terminates.
L:4	Decelerate axis 4 until it terminates.
L:W	Decelerate axis 1 to 4 until they terminate.

4-2-11 L:E Command （Emergency stop command）

(1) Function

It terminates designated axis (stage) immediately.

(2) Example

L:E	Stop axis 1 to 4 immediately.

4-2-12 D command （Speed setting command）

(1) Function

When power is on, start-up speed (S), final speed (F) and acceleration and deceleration time (R) of speed number designated by SPEED SEL in memory switch are set within axis 1 to 4 (slave no. 0 to 3). The travel speed can be altered according to this command.

Setting range

Start-up speed (S)	1～500000pps
Final speed (F)	1～500000pps
Acceleration and deceleration time (R)	1～1000ms

S should be equal to F or smaller.

(2) Example

D:1S100F1000R200	Set travel speed of axis 1(slave No.0) to S=100pps, F=1000pps, R=200ms.
D:4S100F1000R200	Set travel speed of axis 4(slave No.3) to S=100pps, F=1000pps, R=200ms.
D:WS100F1000R200S100F1000R200 S100F1000R200S100F1000R200	Set travel speed of axis 1 to 4 (slave no. 0 to 3) to S=100pps, F=1000pps, R=200ms.

4-2-13 C command （Motor excitation (ON/OFF) command）

(1) Function

This command is to switch ON/OFF the excitation of motor. When excitation is OFF, stage can be manually rotated. It can be switched ON/OFF by putting the 4^{th} digit of command 0 and 1 respectively.

(2) Example

C:10	Switch OFF the excitation of axis 1.
C:41	Switch ON the excitation of axis 4.
C:W1	Switch ON the excitation of axis 1 to 4.

4-2-14 S command （Divide number switching command）

(1) Function

S command is to switch the step angle of motor (number of partitions). Select a step angle among settable 15 kinds of step angle with driver. Assign the number of divide after the 4th digit of command.

Stepping motors rotate 500 steps with 0.72 degrees (basic step angle) per revolution, which means minimum resolution of motor will be 0.72 degrees and the minimum resolution of the stage with1mm lead pitch will be 2μm（=1mm÷500）. Minimum resolution can be altered by parting basic step angle.

Minimum resolution for close control should be set to half the scale resolution or less.

Partition numbers should be assigned on or after the 4th digit of command. Multiple axes can not be assigned simultaneously. Please assign the partition numbers to each axis.

No.of divides	1	2	4	5	8	10	20	25	40	50	80	100	125	200	250
Step angle	0.72	0.36	0.18	0.144	0.09	0.072	0.036	0.0288	0.018	0.0144	0.009	0.0072	0.0058	0.0036	0.0029
Pulse rates per rev.	500	1000	2000	2500	4000	5000	10000	12500	20000	25000	40000	50000	62500	100000	125000
Resolution (μm)	2	1	0.5	0.4	0.25	0.2	0.1	0.08	0.05	0.04	0.025	0.02	0.016	0.01	0.008

※) At Closed Loop control method, similar other than Original position, and do not carry out S command. When similar other than Original position and change motor step angle, because a coordinate position changes, work definitely and not carried out.

(2) Example

S:12	Divide the step angle of axis 1 into 2.
S:280	Devide the step angle of axis 2 into 80.
S:4250	Devide the step angle of axis 4 into 250.

4-2-15 Q command （Status 1 command）

(1) Function

It responds the coordinate value of each axis or controller status.

(2) Example

Q: status 1 command

- 1000, 1000, - 1000, 1000, ACK1, ACK2, ACK3

Numbers parted by 4 commas from the left are coordinate values of axis 1 to 4 (slave No.0 to 3). These values are set to be 10 digits except for commas. Minus sign (-) is to be added on the extreme left. Plus sign (+) is abbreviated. Numbers are represented right-aligned.

The value for open control is pulse rate and for close control is a distance (unit is 0.01microns).

Note the difference in the units applied to the distance of the parameter for M, A commands for close control, which is 1μm, and the distance in response of status 1 command, which is 0.01μm.

ACK1 Acceptance status of command is represented by K or X.

K indicates the command received has been accepted regularly.

X indicates there has been an error (e.g. parameter error, etc) in the command received.

ACK2 Status of limit sensor detection is represented by 1 letter.

K Limit sensor not detected on either axis.

1~E Allocate axis 1-4 to 1-9 in hexadecimal numbers and A to E with 4-bit data from right extremity (LSB). 4-bit data is based on 1 being used when limit sensor is detected on each axis and 0 being when limit sensor is not detected on any axes.

W W will be responded when limit sensor has been detected from all 4 axes, which is supposed to be F in hexadecimal.

ACK3 Controller status is represented by 1 letter.

R Controller is ready for all commands.

B Controller is engaged and only Q, !, L, I, O, and ? commands are acceptable.

Q: S command is also effective in SHOT mode. Refer to the page 4-1-15 for further explanation. Response data format is equal to HIT mode, however, with 4 axes only.

4-2-16 ! command (Status 2 command)

(1) Function

It responds the controller status with busy or ready (ACK3).

(2) Example

! : status 1 command

return date ACK3

ACK3 Controller status is represented by 1 letter.

R Controller is ready for all commands.

B Controller is engaged and only Q, !, L, I, O, ? and P commands are acceptable.

4-2-17 ? command （Read command of Internal information）

(1) Function

It responds internal information of controller.

(2) Example

? : P axis

P Parameter letters. Refer to the below table.

Assign Axis 1-4 or W (all axes). Assign only when parameter letter is P, S, D or B. Otherwise, it is abbreviated.

Parameter letter	Data responded	Examples of data responded
N	Device name	HIT-M
V	Version	V1.00
-	Subversion	001
Z	Mode	0 (SHOT_MODE) 1 (HIT_MODE)
P	Travel per pulse (μm)	1.00 1.00,2.00,1.00,2.00
S	Number of partitions	2 2,2,20,10
D	Travel speed	S100F1000R200
B	Origin return speed	1000,500000,100,200000
L	Program running status	Program No, Program Run, Line No., residual Loop counter (e.g.) 2,1,13, 4 13^{th} line of Program No. 2 is running and count left from loop is 4.

4-2-18 O command (Data Output command)

(1) Function

Output the data of 4-bit through output terminal of I/O connector.

Output value	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
OUT1	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON
OUT2	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON
OUT3	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF	OFF	OFF	ON	ON	ON	ON
OUT4	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON

(2) Example O:14

4-2-19 I command (Data Input command)

(1) Function

Data values of 4-bit at input terminal of I/O connector are responded.

Data values	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
IN1	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON
IN2	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON
IN3	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF	OFF	OFF	ON	ON	ON	ON
IN4	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON

(2) Example

I: 14 Data responded

4-2-20 P command (Embedded program control command)

(1) Function

This command directs program No. selection and execution / stop of embedded program. Refer to chapter 4 for further explanation.

(2) Example

p: P, S, E, U0, U1 can be assigned.

P: Equal to Pn. Program No. can be selected into n and within 0 to 9. Any numbers apart from those will be recognized as an incorrect command and responded by 'NG' sign. Default value is set to 0.

(exe)P:P2 Select program No.2.

S: Start program. Selected program will start.

E: Terminate program. Program will end at the point of when ongoing operation finishes once the termination command has been recognized.

U0: Pause program. Program will pause at the point of when ongoing operation finishes once the command has been recognized.

U1: Restart program. Program will restart which has been paused by P:U0.

4-2-21 B command (Origin return speed setting command)

(1) Function

When power is supplied, start-up speed (S), maximum speed (F), acceleration and deceleration time (R) and mid-speed (M) of speed number that assigned in ORG SPEED n(S), (F), (R) and (M), memory switch, are set to axis 1 to 4 (slave No.0 to 3). By this command, activation speed (S), final speed (F), addition-subtraction speed (R) can be switched. (Note that Mid-speed (M) is not subject to change.)

Settings

Start-up speed (S)	1～500000pps
Final speed (F)	1～500000pps
Acceleration and deceleration time (R)	1～1000ms

S should be equal to F or smaller.

(2) Example

B:1S100F1000R200	Set origin return speed of axis 1 (slave No.0) to S=100pps, F=1000pps, R=200ms.
B:1S100F1000R200	Set origin return speed of axis 4 (slave No.0) to S=100pps, F=1000pps, R=200ms.
B:WS100F1000R200S100F1000R200 S100F1000R200S100F1000R200	Set origin return speed of axis 1 to 4(slave No.0 to 3) to S=100pps, F=1000pps, R=200ms.

4-2-22 Z command (Mode switch command)

(1) Function

This command is to switch HIT mode or SHOT mode.

HIT mode is distinguished from SHOT mode apparently, in command format or what parameter indicates (distance value / pulse rate). Switching the mode during the ongoing operation may cause malfunction. Switching should be made just afterwards the initial settings when needed.

(2) Example

Z:p

p: 0 is to be switched into SHOT mode and 1 into HIT mode.

Z:1 It is to be switched into HIT mode.

4-3.Program functions

10 kinds of program, numbered 0 to 9, can be stored in HIT-M controller. These programs are stored in unerasable memory, which means they will not be erased even when POWER goes OFF. Maximum capacity for each program is 1024 lines. Please use tool software by Sigma Koki when composing, editing, loading and saving programs.

Please set distance modulus (unit 0.01μm) as positioning parameter for HIT/SHOT mode and OPEN/CLOSE control.

Please be aware of that abnormal positioning may occur when Base Rate value on Memory Switch has been misset. Speed No. appointed with Memory Switch is used for travel speed. Travel speed is appointed based on distance modulus and No. of PULSE in HIT mode and SHOT mode respectively.

4-3-1 Program data format

There is a command in a line in this program. Each command consists of up to 20 fields and each field is distinguished by a comma. Different fields are needed depending on type of movement command.

①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭	⑮	⑯	⑰	⑱	⑲	⑳
No	Command	Parameter								Speed Selection								out	wait

①：Line No. Any number between 1 and 1024 can be used but it should be a consecutive number of the previous one.

②：Command code

M：Relative travel positioning

A：Absolute travel positioning

H：Origin return

K：Linear Interpolation movement (capable of up to 3 axes)

E：Circular Interpolation movement

?：IO terminal input confirmation

F：Setup repeating No. (1, 2, 147, 483, or 647 can be input)

N：Stop repeating movement

Y：Exit program

Y should be used for command code for last line in program. Repeated loop nesting between F and N is not applicable.

③～⑩：Travel distance of axis 0 to 7

In case of M/A/H/K/E, it is equal to command specification in HIT mode. Please set distance modulus (unit 0.01μm) as positioning parameter for HIT/SHOT mode and OPEN/CLOSE control. Please be aware of that when Base Rate in Memory Switch is unset, it may interfere with correct positioning.

In case of ? / F, please set 3 only and omit 4 to 10.

In case of N/Y, please omit 3 to 10.

⑪～⑱：Speed settings for axis 0 to 7

Please select one from 4 types of Speed_sel on Memory Switch. In case of K/E, please set 11 only and omit 12 to 18. For command K and E in HIT mode, PULSE speed can be calculated from speed 11, and parameter (in divisions and base rate) of axis with the smallest No. among those in operation. It applies to speed for all interpolation object axes.

In case of H/?/F/N/Y, please omit 11 to 18.

⑲：OUT signal output instructions

Appoint 0 to15. In case of ?/F/N/Y, it will be omitted. When they are not appointed, previous condition remains.

⑳：Waiting time

Any number from 0 to 32767 can be input. (Unit：0.1S)

In case of ?/F/N/Y, it will be omitted.

Please refer to table below regarding whether or not each parameter by command code can be omitted. ◎ indicates 'cannot be omitted', ○ 'omittable in circumstances', and － 'be omitted at all times'in table below.

Command	Axis Parameter								Speed								Out	Wait
②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭	⑮	⑯	⑰	⑱	⑲	⑳
M	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
A	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
H	○	○	○	○	○	○	○	○	－	－	－	－	－	－	－	－	○	○
K	◎	◎	○	◎	◎	○	－	－	◎	－	－	－	－	－	－	－	○	○
E	◎	◎	◎	◎	◎	◎	◎	○	◎	－	－	－	－	－	－	－	○	○
?	◎	－	－	－	－	－	－	－	－	－	－	－	－	－	－	－	－	－
F	◎	－	－	－	－	－	－	－	－	－	－	－	－	－	－	－	－	－
N	－	－	－	－	－	－	－	－	－	－	－	－	－	－	－	－	－	－
Y	－	－	－	－	－	－	－	－	－	－	－	－	－	－	－	－	－	－

4-3-2 Program Examples

1,M,1000,-1000,,,,,1000,1000,1,2,,,,,2,1,15,100

2,A,200000,200000,,,,,300000,300000,3,3,,,,,4,4,10,5

3,H,1,1,1,1,0,0,0,0,,,,,,,,,5,100

4,K,0,1,2,10000,20000,30000,,,3,,,,,,,,1,500

5,E,1,2,3,0,1000000,1000000,180,,4

6,?,3

7,F,1000

8,M,100,,,,,,,,1

9,N

10,Y

1. Travel 10 microns in the +direction at speed 1 on the 0th axis, 10 microns in the –direction at speed 2 on the 1st axis, 10 microns at speed 2 on the 6th axis and 10 microns in the +direction at speed1 on the 7th axis, output out 15 with waiting 10seconds after completion of positioning . (In closed loop)
2. Travel +2mm in the +direction at speed 3 on the 0th axis, +2mm in the +direction at speed 3 on the 1st axis, +3mm at speed 4 on the 6th axis and +3mm in the +direction at speed4 on the 7th axis, output OUT10 with waiting 0.5second after completion of positioning . (In closed loop)
3. Execute ORIGIN return of 0th, 1st, 2nd and 3rd axis, and output OUT5 then 10seconds wait. (* ORIGIN return speed is set by each axis.)
4. Execute 3axies linear travel (linear interpolation) at speed 3on 0th, 1st, 3rd axis move 100 microns, 200 microns, 300 microns (moving sprrd of the long side of the rectangle), output OUT1 with waiting 50 seconds after completion of positioning . (In closed loop).
5. Execute circular interpolation movement linear travel at speed 4 on 2nd, 3rd axis, and move 180 degrees from the current position in CW direction with keeping OUT1 and waiting 0.4seconds after completion of circular interporation (in closed loop).
6. Wating input signal, if INPUT is 3 execute next step.
7.
8. } Repating 1000 times 1 micron move at speed 1 at 0th axis with keeping OUT1。
9.
10. Quit.

4-3-3 Issuing command in program execution

Issuable commands when program is running are as below.

Status ▪ Read series : Command **Q**, Command **!**, Command **?**

I/O control series : Command **O**, Command **I**

Stopping command : Command **L**

Program control command : Command **P** (**P:E** and **P:U0**)

Commands unmentioned above will be treated as fault commands. If they are issued, NG will show.

4-4.Origin Reset Setting

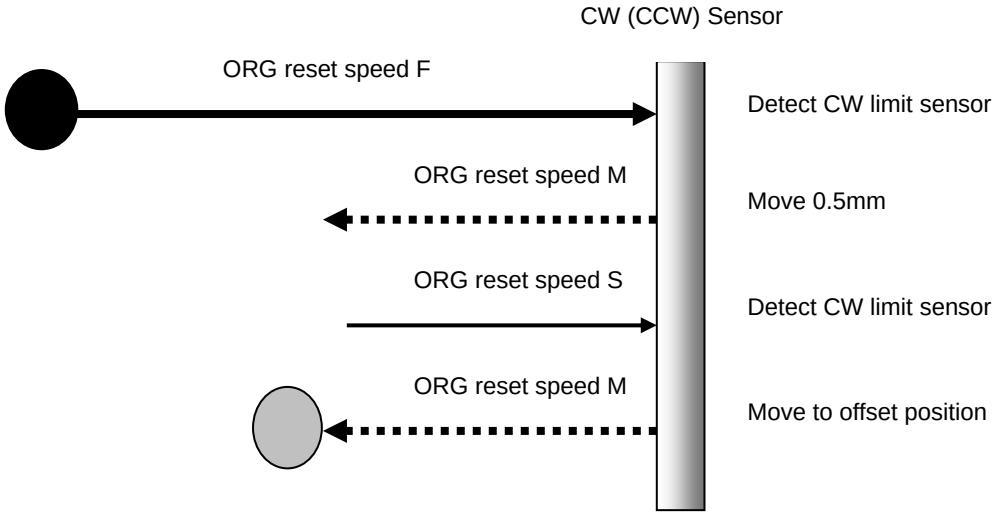
There are six types in Origin Reset setting. Please select optimal Origin Reset setting for stage in use depending upon software.

There are two parameters to do with Origin Reset, which are Origin Reset Speed (S,F,R,M) and Origin offset (ORG offset). Parameters of each slave can be individually set. Please select the optimum value according to the software.

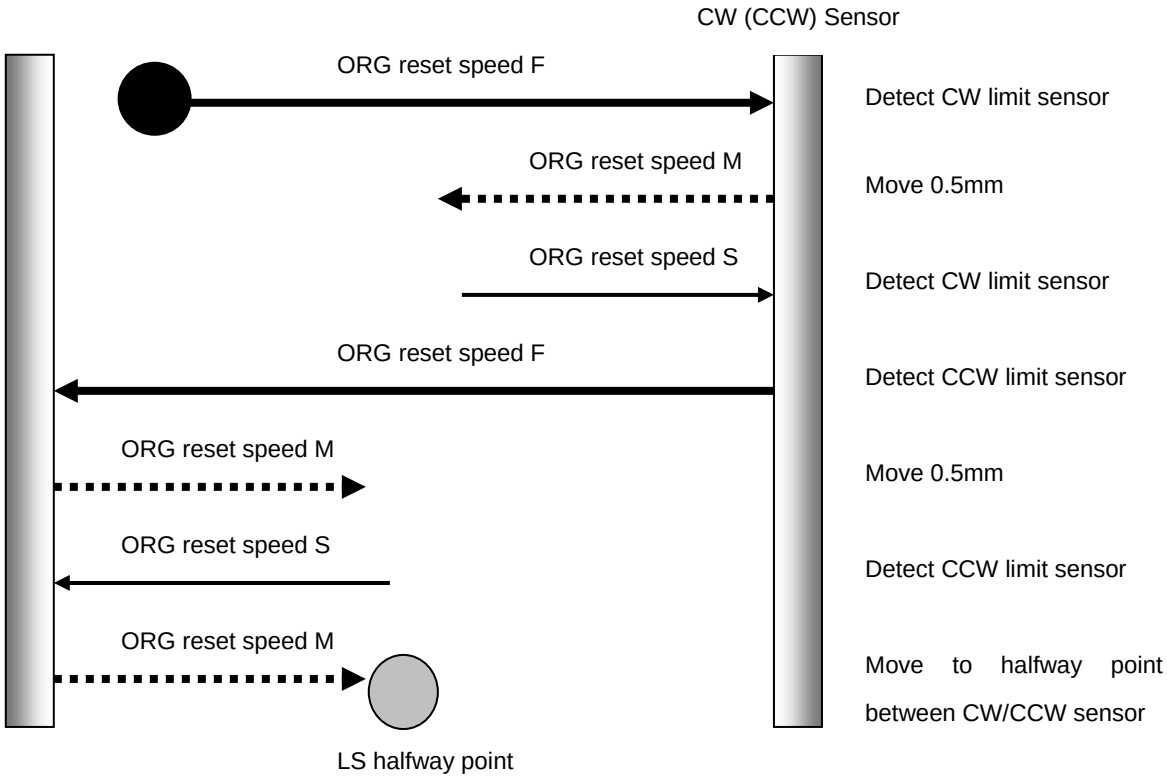
In case of when PGO (Z pulse) is used as an Origin sensor, (ORG5 or ORG6), Origin sensor is not in need at stage since Excitation Reset of motor driver is used.

1, ORG0 Not reset ORGIN position.

2, ORG1 (MINI method compatible, however stage moves to ORG offset value)

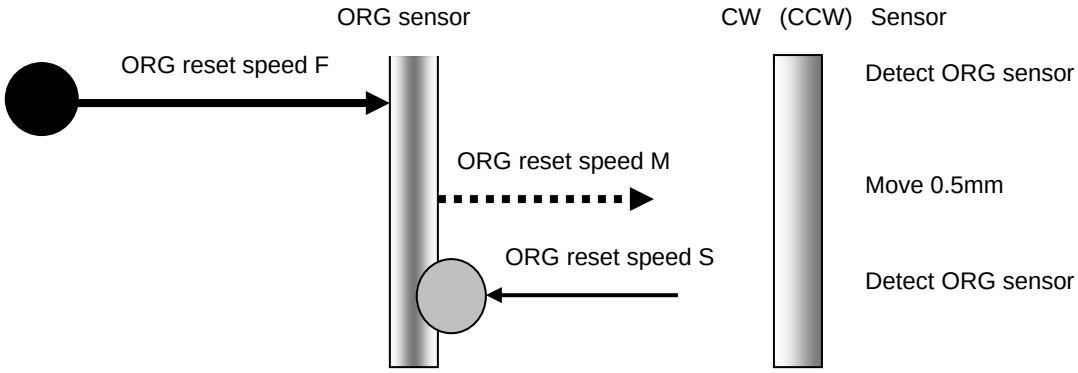


3, ORG2 (MIDDLE method)

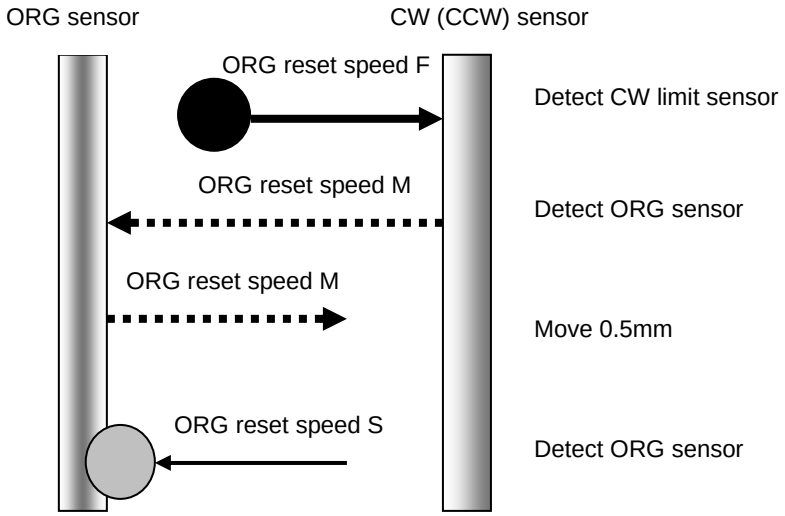


4, ORG3 (for 3 sensor use (LS + ORG))

④-1 In case that ORG sensor is set on the inside of CW(CCW) sensor



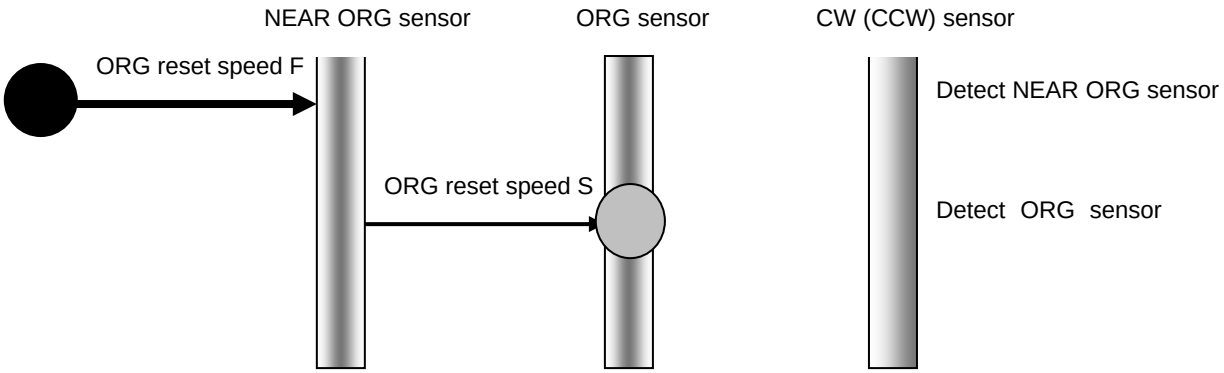
④-2 In case that ORG sensor is set beyond limit SW toward CW direction.



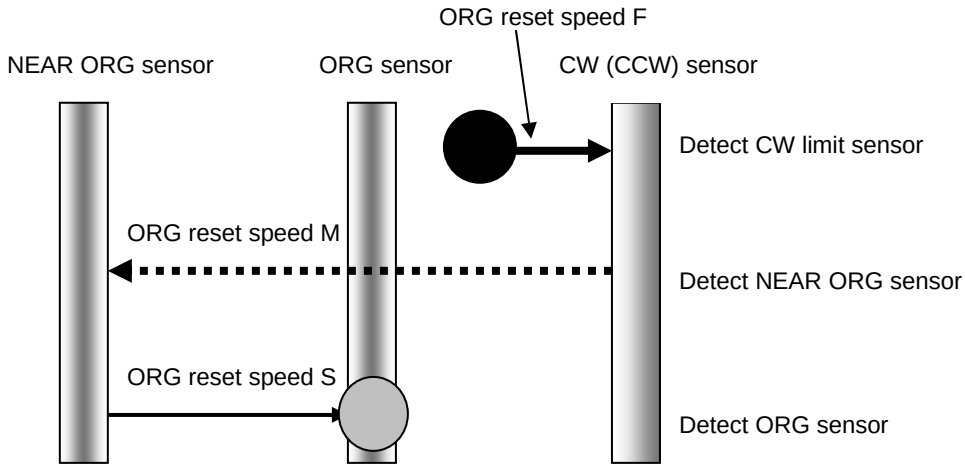
Caution1) In case that after detect CW (CCW) sensor, stage move toward CCW direction and then can not detect ORG sensor (in case of no ORG sensor), stage stop at CCW (CW) sensor position.

5, ORG4 (for 4 sensor (LS+SD+ORG) use.)

⑤-1 In case that NEAR ORG sensor is on the inside of CW(CCW) sensor.



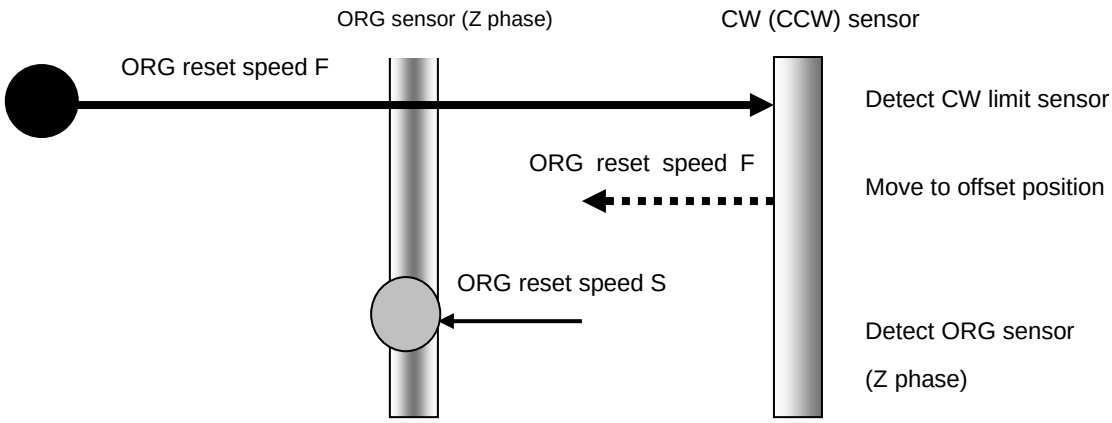
⑤-2 In case that ORG sensor is beyond NEAR ORG sensor toward CW(CCW) direction.



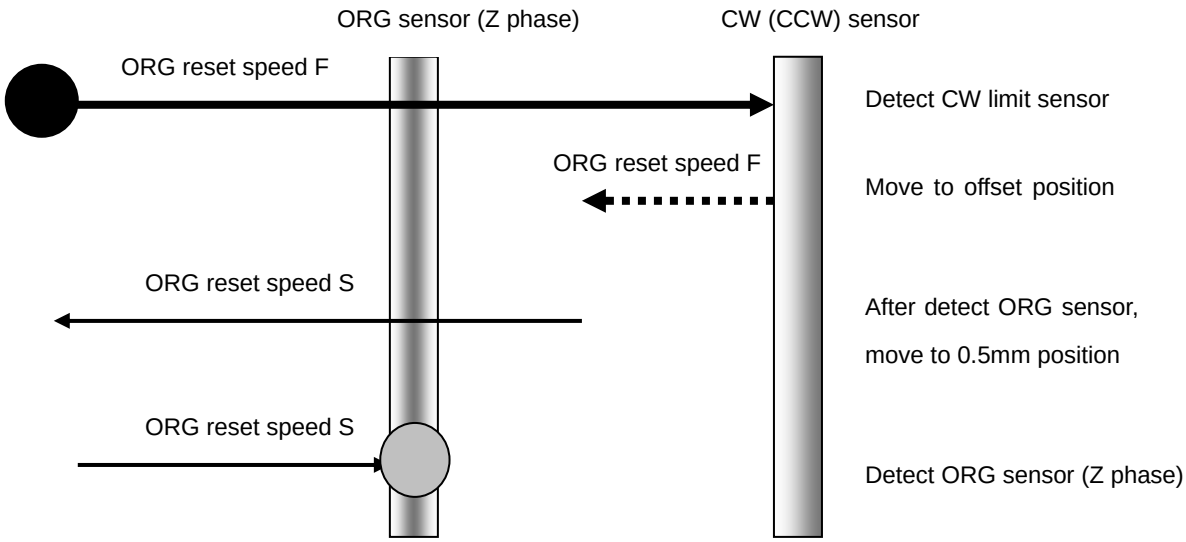
Caution1) In case that after detect CW (CCW) sensor, stage move toward CCW direction and then can not detect ORG sensor (in case of no ORG sensor), stage stop at CCW (CW) sensor position.

Caution 2) In case that after detect NEAR ORG sensor, stage move toward CW direction and then can not detect ORG sensor (in case of no ORG sensor), stage stop at CW (CCW) sensor position.

6, ORG5 (for 3 sensor use (LS+ORG(Z phase)))



7, ORG6 (for 3 sensor use (LS+ORG(Z phase)))


ORG sensor (Z phase)
CW (CCW) sensor
ORG reset speed F
Detect CW limit sensor
ORG reset speed F
Move to offset position
ORG reset speed S
After detect ORG sensor,
move to 0.5mm position
ORG reset speed S
Detect ORG sensor (Z phase)

4-5.Emergency STOP

The connector model “MSTB2,5/2-GF-5,08” (PHOENIX CONTACT Inc.) is used.

When in use, connect a plug component “MSTB2,5/2-STF-5,08” (PHOENIX CONTACT Inc.) that attached to the product.

The EMG_STOP switch operates in the logic of “Normal Close”. Attach a jumper wire while normal operation.

Please note that “EMG STOP” is triggered at the rising edge from CLOSE to OPEN. It is not triggered by the signal level.

For each slave axes, the motor excitation ON/OFF status during activation of the EMG STOP is selectable. (Use memory switch (No.130) to (No.137) “EMG Excitation” for this setting.)

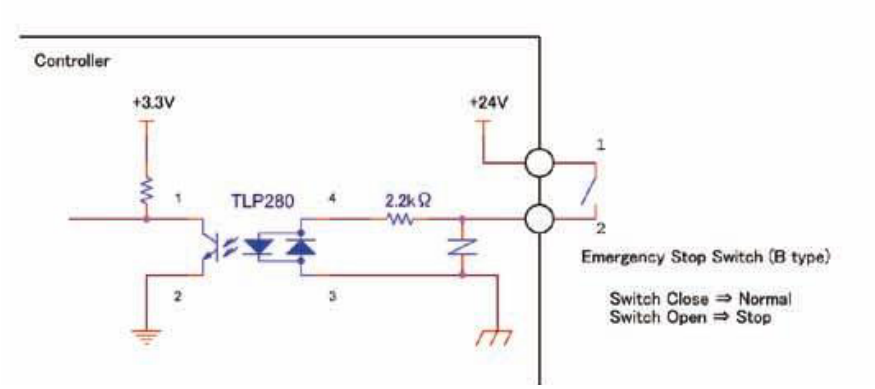


Fig. 4-5-1： An Example of “EMG_STOP Switch” connection

Chapter 5: Rotation Stage

Mainly listed it to a foregoing chapter about a Translation stage, but list it in this chapter about an item peculiar to a rotaion stage.

In the case of closing designation and HIT-mode, appoint movement distance by A command and the M command of the Translation stage in SHOT-mode.

On the other hand, in the case of Gonio-Stage such as rotation stage or SGSP-60A75 such as SGSP-120YAW, it is necessary to set it at a rotary angle not movement distance.

5-1.HIT mode

5-1-1 Settting item

Base Rate　(Memory-SW)：Set the travel Rotaly angle per 1 full step pulse for each axis. (Setting Unit：0.001°　)

RES_UNIT　(Memory-SW)：Set Scale resolution and direction.　(Setting Unit:0.00001°)

[Example] Because a rotary angle per 1 pulse at the time of the full step is 0.005 degrees, in the case of SGSP-120YAW, Base Rate sets it to 5. When connect a rotary scale of 0.00018 degrees per 1 pulse, set it with 18 in RES_UNIT.

In addition, the rotary angle per 1 pulse of the motor driver becomes 0.0001 degrees (= 0.005 /50) when set Divide to 50 and becomes easy to treat it because agree with the 0.0001 degrees unit of A command and the M command.

5-1-2 Command/ Status

A command, M command: Set a rotary angle with the integer of the 0.0001 degrees unit.

The positional information that is sent back by Q command: send back a position at an angle of a 0.0001 degrees unit now.

[Example] When turn 45 degrees by M command, set it with M:45000.

When it is sent back with 450000 by Q command, a position shows that it is 45.0000 degrees now.

5-1-3 Speed

Speed setting with memory switch in the case of a rotation stage or the speed to set by D command and B command a rotary angle (set it in 0.0001 degrees unit) / second.)

[Example] In the case of 300000, F speed shows 300,000 × 0.0001 degree = 30 degrees/s.

5-2.SHOT Mode [Close loop control]

Because set all items by a number of the pulses unit in the case of open loop control of SHOT-Mode, in the case of a Translation stage, there is not the difference. (Do not use Base Rate and RES_UNIT in the open loop control.)

Only in the case of close loop control, there is a difference following than a Translation stage in SHOT-Mode.

5-2-1 Settting item

Base Rate (Memory-SW)：Set the travel Rotaly angle per 1 full step pulse for each axis. (Setting Unit：0.001°)

RES_UNIT (Memory-SW)：Set Scale resolution and direction. (Setting Unit:0.00001°)

[Example] Because a rotary angle per 1 pulse at the time of the full step is 0.005 degrees, in the case of SGSP-120YAW, Base Rate sets it to 5. When connect a rotary scale of 0.00018 degrees per 1 pulse, set it with 18 in RES_UNIT.

5-2-2 Command/ Status

A command, M command: set a rotary angle with the integer of the 0.01 degrees unit.

The positional information that is sent back by Q command: send back a position at an angle of a 0.0001 degrees unit now.

[Example] When turn 45 degrees by M command, set it with M:1+P4500.

When it is sent back with 450000 by Q command, a position shows that it is 45.0000 degrees now.

Chapter 6: Specifications

6-1.Specifications

1. General Specifications

Master	Power Supply	DC24V/1A
	Operating Temperature	5~40℃
	Storage Temperature	-20~60℃
	Ambient Humidity	20~80%RH (No Condensation)
	Altitude	up to 2000m
	Indoor use only	
	Installation category	Ⅱ
	Pollution degree	2
	External Dimensions	130mm x 120mm x 50mm
	Weight	620g
Slave	Power Supply	DC24V/1A
	Operating Temperature	5~40℃
	Storage Temperature	-20~60℃
	Ambient Humidity	20~80%RH (No Condensation)
	Altitude	up to 2000m
	Indoor use only	
	Installation category	Ⅱ
	Pollution degree	2
	External Dimensions	130mm x 120mm x 50mm
	Weight	630g

2. Performance

Controlling Axis/Axes		up to 8 axes
Maximum Driving Speed (F)		0.01~9999999.99μm/s (1~500000PPS)
Minimum Driving Spped (S)		0.01~9999999.99μm/s (1~500000PPS)
Maximum No.of travel pulse		-134217728 (Pulse) ~ +134217727 (Pulse)
Acceleration/Deceleration Time (R)		1 ~ 1000ms
Sensor Input	Origin sensor / Proximity sensor /CW(-) Limit /CCW(+)Limit	
	(Memory switches can be used to change input logic for sensors.)	
Interface	RS232C Interface	
	Communication Parameters	
	・Baud Rate	4800/9600/19200/38400/57600bps
	・Data Bits	8bit

	・Parity	None
	・Stop Bit	1bit
	・Flow Control	Hardware
	・Delimiters	CR+LF
	USB Interface	
	・Transmission Speed	Full speed Mode 12Mbps
	Ethernet Interface	
	・Data Rate	10/100Mbps(half duplex)
	・Maximum Data Length	256Byte
I/O	Input 4-pin (Photo-coupler Input, Internal Resistance 2.2kΩ)	
	Output 4-pin (Open-collector Output Maximum Use Conditions DC24V 50mA)	

3. Driver Specifications

Driver Type	Bi-polar pentagon micro-steps system
Driving Electric Current	0.1A/Phase~1.1A/Phase
Current Down	0.1A/Phase~0.7A/Phase
Division settings	1,2,4,5,8,10,20,25,40,50,80,100,125,200,250 divisions

4. Electrical Fast Transient / Burst Noise

EN61000-4-4(2004) Level 2

5. Surge Noise

EN61000-4-5(2006) Level 2

6. Electrostatic Immunity

EN61000-4-2(1995)+A1(1998)+A2(2001) Level 2

6-2.Connector Pin Assignments

6-2-1 I/O Connector

No.	Description	No.	Description
1	IN COM	11	IN1
2	IN2	12	IN3
3	IN4	13	-
4	-	14	-
5	OUT1 (H)	15	OUT1 (L)
6	OUT2 (H)	16	OUT2 (L)
7	OUT3 (H)	17	OUT3 (L)
8	OUT4 (H)	18	OUT4 (L)
9	-	19	-
10	+V (DC24V)	20	GND

Connector 10220-52A2PE (by Sumitomo 3M Limited) used

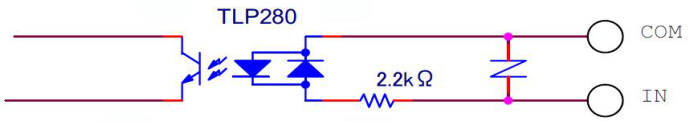


Figure 5-2-1：IN1～4 Input Circuit Diagram

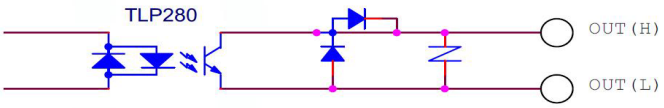


Figure 5-2-2：OUT1～4 Output Circuit Diagram

6-2-2 STAGE1～8 Connector

No.	Description	No.	Description
1	Blue：Motor	9	GND：Electromagnetic Brake
2	Red：Motor	10	+24V：Electromagnetic Brake
3	Orange：Motor	11	LS(+)：positive side Limit detection
4	Green：Motor	12	LS(-)：negative side Limit detection
5	Black：：Motor	13	(GND)
6	GND	14	NEAR：proximity detection
7	ORG：Mechanical origin detection	15	(Sensor Power Source)
8	Sensor Power Source		

Connector XM2D-1501 (By Omron) used

6-2-3 SCALE1～8 Connector

No.	Description	No.	Description
1	GND	9	Alarm-
2	GND	10	A+
3	+5V	11	A-
4	+5V	12	B+
5	-	13	B-
6	-	14	-
7	-	15	FG
8	-		

Connector XM4L-1542-112 (By Omron) used

6-2-4 RS232C Connector

No.	Description	No.	Description
1	-	6	DTR
2	TxD	7	CTS
3	RxD	8	RTS
4	DSR	9	-
5	SG		

Connector XM3B-0922-132 (By Omron) used

6-2-5 USB Connector

No.	Description	No.	Description
1	-	3	DATA+
2	DATA-	4	GND

Connector XM7B-0442 (By Omron) used

6-2-6 ETHERNET Connector

No.	Description	No.	Description
1	Tx+	5	-
2	Tx-	6	Rx-
3	Rx+	7	-
4	-	8	-

Connector J0011D21BNL (By PULSE) used

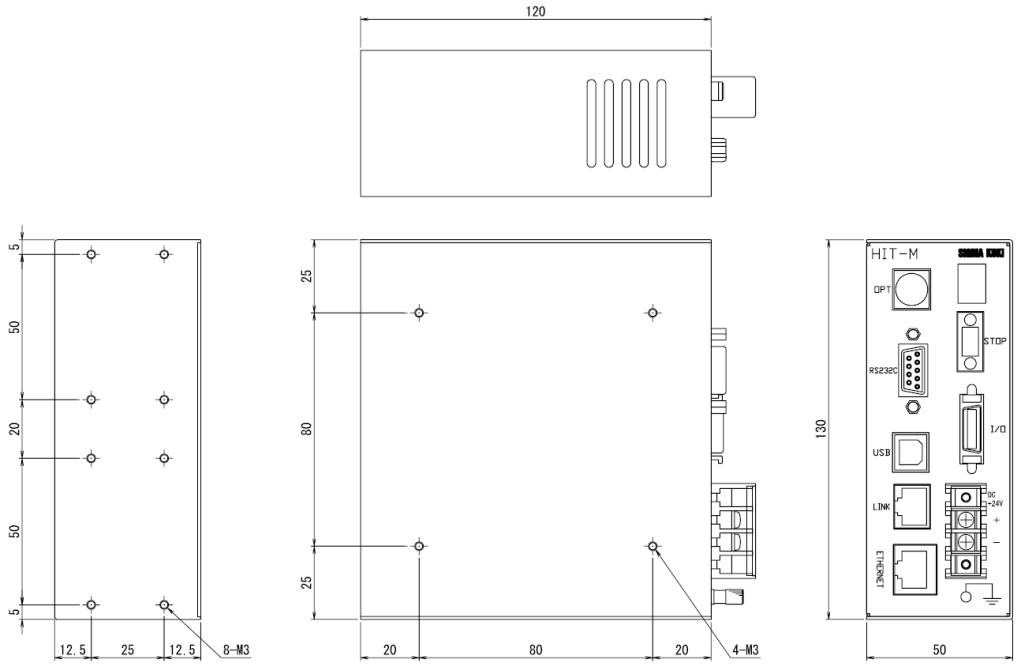
6-2-7 LINK Connector

No.	Description	No.	Description
1	-	5	-
2	-	6	DATA-
3	DATA+	7	-
4	-	8	-

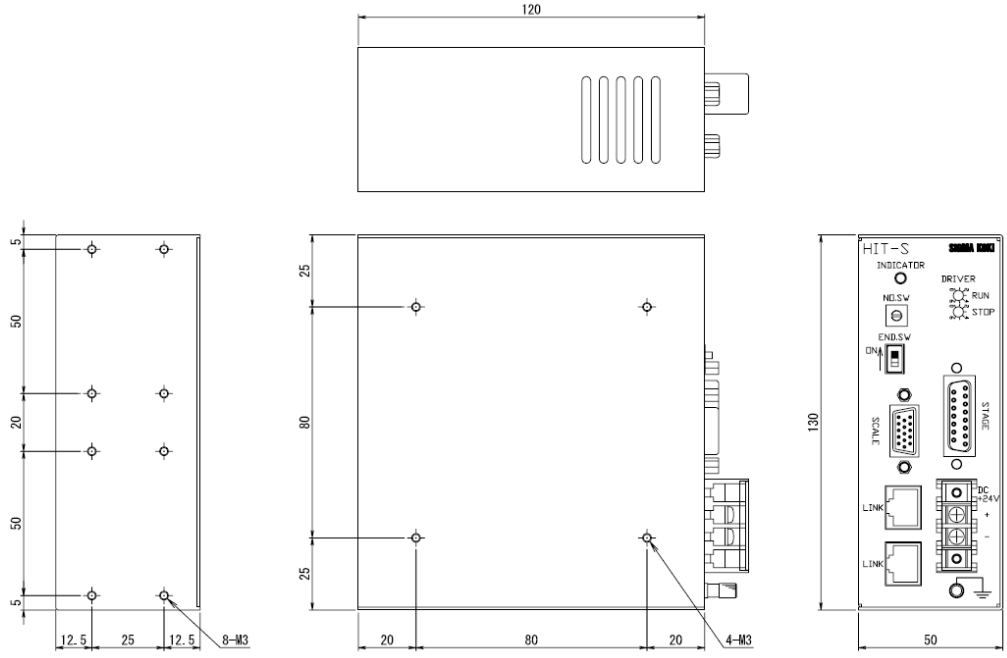
Connector TM11R-5LF-88(50) (By Hirose Electric) used

6-3.Outlines

(1) HIT-M Outlines



(2) HIT-S Outlines



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